The AMSAT® Journal

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AMSAT at National Space Day. Astronaut and Senator John Glenn autographs an AMSAT microsat model for Mark Kanawati, N4TPY at AMSAT's exhibit at National Space Day held at the Smithsonian National Air and Space Museum, Washington, DC on 03 May 2001. AMSAT displayed many items for the public attending National Space Day including a microsat mechanical test model. Also many local grade school students, who may be our future AMSAT satellite designers, spent much time at the AMSAT exhibit constructing their own microsatellite prototype. Many local AMSAT members represented AMSAT at National Space Day exhibit including Founding President Emeritus Perry Klein, W3PK (background). Other visitors to the AMSAT display were NASA Astronaut Dr. Thomas Jones and Dr. John Dailey, Director of the Smithsonian National Air and Space Museum. For more photos and news on AMSAT at National Space Day see page 31 of this issue. (Photo by Art Feller, W4ART)

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AMSAT Journal Telemetry

A Letter to the Editor

To Editor, *The AMSAT Journal*:

I always enjoy reading *The AMSAT Journal*. For the past few years, except for a rare RS-12 contact, it's been my only involvement with satellites. The January/February issue was particularly interesting, both with Dick Jansson's proposed "P3E" and the BoD report, since they both really pose the question that we've all been asking ourselves lately, "where do we go from here". As important as the technical discussions are, I believe the "user community" is even more important, and, I feel, frequently ignored.

As in most organizations, our efforts are primarily managed by a capable few. Several dozen key individuals perform most of the work (and I thank God for their existance). Add the "Area Coordinators" and others interested enough to be willing to travel cross-country for an AMSAT Symposium, and you expand the group to several hundred. However, our membership is in the thousands. For the vast majority of us (over 90 percent of the membership), our participation is in the use of the satellites' transponders, once launched and operable, not dealing with the technical complexities of design, construction, and launch.

The interests and desires of the potential user should not take a back seat to the technical achievements proposed. While AMSAT marked time over the past several years waiting for Phase 3D, the amateur community languished, and reverted to the use of satellites provided by other nations' organizations. Dick's proposal is good, since it would get many of us back into "operating mode." Yet, at the same time, why rule out LEO's? The "easysats" have provided many the opportunity to get their feet wet, yet we have to thank the Russians for providing them. Use of Japan's FO-20 and FO-29 requires just a bit more effort. This country has failed to provide introductory analog transponder satellites (except AO-27) since the demise of the single-digit OSCARs, which were long gone by the time I became involved with amateur satellites in the mid '80's. In fact, at the present time, our only current contributions to the amateur satellite community (besides AO-27) are two sick birds, AO-10 and AO-40, which require (or will require) fairly elaborate equipment for their use. The run of the mill amateur community will not get involved with satellites if it requires an extensive expenditure of funds to participate, even on a beginning basis. Perhaps that's one reason why only about one percent of U.S. hams are AMSAT members. The reason that RS-12/15 and AO-27 are so popular is because the average ham may very likely have the means already available to try them out.

I understand the desire among the developer community to *push the envelope* and incorporate the latest technologies in proposed satellites. While commendable, this may not encourage the average ham to get involved. He's not likely to go out and buy a 9600 baud modem, or a rig that can handle it, or a PSK Manchester modem, just to try out a digital satellite to see if he likes it. Similarly, he's not likely to go out and buy expensive transmitting or receiving equipment and antennas operating in the bands above 70cm if his only application will be limited satellite use. Also, it makes no sense to put transponder capabilities on a satellite, when the needed equipment won't be readily available to the average amateur until the expected life of the satellite is more than half over.

While I realize the spectrum available for satellite use below 440 MHz is limited, it is also where we will find the greatest user support. There was initial concern that use of AO-13's mode J would have to be limited, but in fact it became my workhorse for satellite operation for a number of years, as it was for many others. A two-meter multimode and 435-437 MHz receiving converter provided many fine contacts on AO-13 and FO-12/20. When the transponder died, my satellite operation waned considerably. Although technology has advanced significantly since those days, still we will eliminate many potential users of our satellites if we require capability above 70cm. This may not be an option with AO-40 unless some of the lower frequency transponders can be made operable. However, future satellites, whether high orbit or low, should incorporate such transponders. Not only is ground station equipment expense a factor, but so is antenna location. Unless one has a pretty clear shot in the needed directions, you can pretty much forget about satellite operation when microwave frequencies are required. I, for one, am now in a new location that is heavily wooded, severely limiting access for satellite reception, particularly at the higher frequencies.

While I do not suggest limiting the development of new and state of the art technologies, I do feel that our continued success is dependent upon ensuring, through adequate financial support, that we have the means to continue. Thus dictates (1) providing satellites that are economical to produce (by keeping them simple), so that we don't duplicate the financial drain that was attributable to AO-40, and (2) providing satellites that the average ham can easily use, thus maintaining interest throughout the amateur community.

This letter was nearly completed before I attended the recent Washington, DC, AMSAT meeting, and before I read KC4YER's section on "AMSAT Looks Ahead" in his "Amateur Satellites" in May 2001 issue of *CQ* magazine. Listening to the excellent speakers at that meeting, and reading the *CQ* column, merely served to reinforce the proceeding comments.

Richard W. Maylott, W2YE

Robin Haighton, VE3FRH responds:

Richard Maylott's letter raises a number of points, which I feel should be answered as he, like many others, does not always get the opportunity to attend Board meetings and hear the rational of the decisions which are made.

Richard's makes the comment that the "user community" is even more important, is quite correct. Without the user community we would not be able to carry out our work as they supply a significant amount of the funding to AMSAT projects, but then Richard also comments that they are (he feels) frequently ignored. Well this is always a problem in many organizations, where and how do we get most of our feedback from our members? In AMSAT-NA we get most of our feedback from our amsat-bb, where there are ongoing discussions on many topics all the time. However we do get additional feedback from letters (such as Richard's) and the various hamfests, AMSAT meetings including Dayton, club meetings and e-mail sent directly to me and other officers of AMSAT. We, the Board of Directors, try to balance the membership feedback with the desires of the technical group, when we are trying to decide "What's next?"

We have not ruled out the "LEO's" but on the next project we felt that a GTO satellite would provide more operating time for the membership and provide greater coverage of the earth, enabling many contacts between more remote points than is available by using a LEO satellite. Now that several universities are designing and building LEO micro-satellites the time has come for AMSAT to develop more new ideas "pushing the envelope" a little further and remaining at the forefront of the Amateur Technology and to leave the older modes to the other satellite builders.

Our new satellite, currently under design, will contain some modulation techniques which we believe will reduce the need for large and expensive antenna systems, possibly allowing apartment dwellers to utilize the satellite with a relatively simple antenna. This we hope will attract many more amateurs to satellite operation and AMSAT membership. Our objectives with the new satellite meet exactly those that Richard has listed in his letter:

(1) Providing satellites that are economical to produce (by keeping them simple) and

(2) providing satellites that the average ham can easily use, thus maintaining interest throughout the amateur community.

Sincerely, I hope that the Board of Directors and officers of AMSAT are maintaining that delicate balance between members requirements, and technical advancement, however there are ways in which you the members can make your point:

Firstly become an AMSAT volunteer, you don't have to be a technical wizard, and we have plenty of non-technical jobs awaiting your skills. As an AMSAT volunteer you will always be noticed and have plenty of opportunities to make your thoughts known.

Secondly, communicate with your AMSAT area coordinators and officers, keep in touch and let us know what you are thinking, Richard did just that, hence this letter in reply.

Thirdly, see us at your hamfest, invite us to be there, come and talk to us. Be at Dayton, AMSAT is there every year and the President together with Board Members and officers will be pleased to see you and listen to what you have to say.

73,

Robin Haighton VE3FRH
President, AMSAT-NA

OPAL Available for UI-Digipeating

Bob Bruninga, WB4APR reports via amsat-bb that OPAL has been enabled for UI-Digipeating (APRS) for several months. Recently Tim Cunningham, KF6RFX has verified OPAL as a digipeater. The OPAL digipeating frequency is is 437.100 MHz up and down via 9600 baud.

[Continued on page 24]

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Dedication!

Well it has happened! AO-40 is available for general use for the first time. Yes somewhat experimental, but generally good signals from all over the world. It would have been easy in December last year to have written the satellite off and said that it had failed, but NO! Several dedicated people have spent nearly all of their free time investigating, trying ideas, and succeeding to bring the satellite back to life.

As I am writing this in early May I will not give you a status report here, because by the time you read Apogee View in June things will certainly have changed. But I can tell you that without the dedication of the design team and the controllers, over the past few months we would not have a working satellite today. My faith in these people had not wavered, and last December I bought a new downconverter that I installed this past mid-winter to download the telemetry at 2.4 GHz. Then fortunately I was ready when on 05 May 2001 as I was among the early risers and making contacts on AO-40. There is nothing quite so satisfying as working a new satellite, it is always a highlight of my ham existence, and AO-40 even more so, as we have lived with it for so long and then wondered if it was going to live up to expectations. Thanks to all of the *Team*!

At Dayton this year, AMSAT introduced the *Presidents Club* for regular donors to AMSAT who provide sustaining funding to our projects. There are two level of donors a *Gold* level for people who provide $100 or more each month ($1200 or more per year) and a *Silver* level for members who provide $50 or more each month ($600 or more per year). There are quite a few members who provide this sort of funding, and most of them do so without any recognition. If you are interested in becoming a donor and supporter of AMSAT, please call Martha at the office and she will be pleased to enroll you as a *Presidents Club Sustaining Donor* at the appropriate level. Martha will also advise you of the benefits of being a donor, one of which may be a tax receipt. (Also discuss this with your tax advisor).

Many discussions are now going on concerning our next satellite which we hope will be launched in the 2004/2005 time frame. In addition to our project committee who will decide on the basic parameters of the satellite, initial communications are being carried out with possible launch agencies, and I would like to be in a position to advise you about this important aspect later in the year. The choice of the launch agency and making an agreement with them is a major step in the development of any satellite as it determines size, weight, shape and orbit parameters as well as the schedule and cost. In the past we have often had the launch opportunity before the design has started, and dependent on launch availability our project ideas could be changed this time.

One final thought, it is important that each and every officer of AMSAT should have his own *backup* - even the President. Through this column I ask every officer to have a designated backup and to let me know who it is before the Annual Meeting in Atlanta. In case of illness or other disability it is essential to have a backup.

If you, the reader of this column, feel that there is a job in AMSAT that you would like to do or one for which you would like to be trained as a backup, please let me know.

Fortunately I do have a backup - the Executive Vice President!

73,

Robin Haighton, VE3FRH

President ■

Congratulations AMSAT On The Launch Of Phase 3D

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Special Event Station - N4ISS

November 4 the International Space Station - 02-10 December 2000

Al Lark, KD4SFF

"GREAT NEWS Al, you just made my weekend. WOW that was crazy on AO-10. I haven't heard it like that since S92RS was on. Great idea on the ISS Special Event! I hope you have it on again. It was a HUGE SUCCESS! Thank you very much for the contact! 73, Steve, KB8VAO." Steve's e-mail was among the many appreciative comments we received, regarding our *N4ISS Special Event* operation.

The idea came to me in late September, while on vacation with my wife Sue. I was relaxing on the beach at Kelley's Island, Ohio. Hypnotized by the waves of the Great Lake Erie, my thoughts drifted toward the significance of the upcoming October 31st launch of the Expedition One Crew. Commander William "Shep" Shepherd (Capt., USN), Soyuz Commander Yuri Gidzenko (Lt. Col., Russian Air Force), and Russian Flight Engineer, Sergei Krikalev, will climb aboard a Russian Soyuz rocket and blast off toward the ISS. Then, just two days later, on November 2nd they will dock, becoming the "First Crew" to begin the permanent occupancy of the "International Space Station".

Yuri Gidzenko had previously spent 179 days in space as Commander of Russia's *Mir* (*Peace* in Russian) Space Station, and is making his second trip into space. He will be responsible for the launch and docking of the Soyuz to the ISS. Sergei Krikalev, by far, has the most time of this crew in space. With this mission, he will be adding over four months to his 484 days in space. His responsibilities will include Flight Engineer during launch, and for the majority of the ISS systems. Sergei will also become the "first" person to visit the ISS twice, having flown on the Space Shuttle Endeavour in December 1998. That mission mated the Unity to the Zarya module, in the initial ISS assembly flight! William "Shep" Shepard will be in charge of the overall success and safety of the mission. He will also be the second American astronaut to be launched aboard a Soyuz capsule. Dr. Norman "Norm" Thagard was the first American astronaut to experience a ride on the mighty Soyuz and reside aboard the *Mir*.

The thought of Dr. Thagard's 1995 stay on *Mir*-18, brought back fond memories of our Experimenters Group Amateur Radio Club's, "Easter Morning MAREX Contact," between Norm, and several young Amateur Radio operators. We, along with many other folks around the world, experienced a tremendous amount of excitement and joy from the countless ham radio QSO's with the various crews of the *Mir* Space Station and Space Shuttles. I was also aware of the importance that Amateur Radio played in the space program. Not only was ham radio vital to the crews' moral, by providing them with communication to family, friends, and some very lucky ham radio operators, but also served as a backup mode, if other communication systems failed. Another benefit was the tremendous amount of interest, in the sciences and space program that was created through prearranged contacts with school children. For these reasons, ARISS was included as a payload aboard the ISS. Three countries have even assigned special Amateur Radio callsigns for their crew's use on the ISS. The United States is NA1SS, and the Russian's is RS0ISS for voice. There is also the callsign RZ3DZR for the station's TNC, which is used for packet radio computer communication. Two of the Expedition One crew also have personal Amateur Radio callsigns. Sergei's call is U5MIR and Shep's is KD5GSL. I wanted to somehow mark this new era of Amateur Radio aboard the ISS.

I knew it would be too late to organize anything worthwhile by November. But on December 2nd, just one month later, another monumental event would occur. The STS-97 Endeavour's International Crew - Commander Brent Jett, Pilot Michael Bloomfield, Mission Specialists Joseph Tanner, Carlos Noriega and Canadian Space Agency astronaut Marc Garneau, would dock to the ISS. Thus, becoming the First Crew to visit the newly inhabited ISS. They would be delivering the first set of U.S. provided solar arrays and batteries, called the P6 Photovoltaic Module or PVM. The gigantic 240-foot solar arrays will increase the station's electrical power five times, which is vital for future research. This addition will also make the ISS the longest structure to ever fly in space!

It then came to me...why not combine these two historic occasions! Our club could celebrate the manning of the ISS, and the docking of the STS-97 Endeavour Crew, by hosting an *Extra Special, Special Event*. This would enable us to utilize our unique club callsign N4ISS as "November 4 the International Space Station"!

We, the Experimenters Group ARC - N4ISS, believe the International Space Station to be one of mankind's greatest achievements of the millennium. Not only for science, but more importantly, a superb vehicle to unite the nations of our world together in peace. And through the use of the wonderful ARISS program, interest youth, (our future) in the sciences. Wanting to have our club reflect these ideals, we applied for, and then received, the

Figure 1. Working N4ISS: From left to right, Al Lark, KD4SFF, Sue Lark, Pete Theiler, KI4KN, and Fred Tuck, Jr., WD4KTI.

N4ISS vanity callsign for our club station. That was a year ago, on 04 December 1999. This callsign is also used for our SAREX retransmission station.

With all these thoughts in mind, I noticed it was about time for the Sunday's 20 Meter International AMSAT Net. I went back to our motor home and tuned my Yaesu FT-847 to 14.282 MHz., which was connected to an ATAS-100 antenna, located on the roof. I heard net controller, Keith Pugh, W5IU calling for check-ins to the net. Keying the mic, I called "W5IU this is KD4SFF portable 8." Keith swung his beam to the northeast and returned my call. I told him my QTH was Kelley's Island, Ohio, and we were having a great time on vacation. I then told Keith about my Special Event plans for the ISS and Endeavour. Keith thought it was a great idea, and announced it to the net. No turning back now... I was committed. Lots of ideas started flowing through my head. I couldn't wait to return home to launch them into reality.

One of the first things, after returning from our vacation, would be to call the club members. I would explain the significance of our new project, and ask for assistance. Among those, was fellow space enthusiast, Fred Tuck Jr., WD4KTI, who has been invaluable in our club's past undertakings. Fred thought my idea was fantastic, and also believed it would be a great way to enlighten folks about the ARISS program. The next thing on the agenda was to have our event published in the "Special Events Section" of the December issue *QST*. Time was running out, so I immediately e-mailed Rosalie White, K1STO, about our special event plans. Rosalie replied, expressing that the idea sounded grand, and managed to get it into *QST*, at the very last moment! For frequencies, we chose 28.497, 14.297, 7.297 MHz for STS-97. In addition, we included FM satellite AO-27, since I'm the AMSAT Area Coordinator for the upstate South Carolina. I also e-mailed friend, and fellow JSC ARC member, Kent Castle, W5OJ, and told him of our special event. He readily volunteered to participate by operating W5RRR, from the Johnson Space Center ARC station!

Many people were very helpful in getting the word out, about our special event. The ARRL listed our special event on their WWW site, and also in *The ARRL Letter*. AMSAT carried it in their *AMSAT News Service* bulletins. Dale Martin, KG5U, who is the president of the Johnson Space Center ARC, included our event in the club's newsletter *The Uplink*. Dale had even requested volunteers to support the special event, by manning W5RRR.

ГИДЗЕНКО КРИКАЛЕВ SHEPHERD
International Space Station
STS-97 Endeavour
Special Event Station
December 2-10, 2000
TANNER BLOOMFIELD JETT GARNEAU NORCROSS
N4ISS
Experimenters Group ARC
W5RRR - K1ISS - K2ISS - KA2ISS - K3ISS - KG4ISS - W5ISS - KD5ISS - N6ISS - WA3NAN
Confirms and thanks you for your participation in, and support of, the celebration of the manning of the ISS and docking of STS-97 Endeavour
S97E5096 2000/12/09 19:47:28

Figure 2. N4ISS QSL Certificate.

Our club wrote to all of the ISS suffix callsign stations in the US, which numbered over 40, and invited them to participate. To make it as easy as possible for them, we would act as the QSL manager. In return, all they needed to do was work as many stations as they could spare the time for. Afterwards, they could just return their log in the enclosed SASE, and we would take care of the rest!

To make our special event, even more exciting, we decided to have four different levels of achievement. They would be:

1 point = Lift-off, 2 points = Orbit, 3 points = Docking, 4 points = EVA

Each ISS station contact, per band, counted as 1 point. Satellite contacts counted as 2 points. And contacts with W5RRR were 3 points. In addition, we issued an extra special *Board the ISS* certificate to the participating ISS-stations. To top-it-off, we would award the station(s) with the most points an ARISS t-shirt!

Finally our big day had arrived! All the plans had been laid, and so began the countdown. The Experimenters Group ARC - N4ISS Special Event operation lifted-off on Saturday, 03 December 2000, on AO-27. I had put the word out earlier, of my satellite schedule, via e-mail on the AMSAT SAREX BBS. The first satellite pass of the day was at 1312 UTC. Being that it was such a low pass, I was only able to work two stations. The following pass at 1444 UTC had a much better elevation. This time, I had better signals into the bird, and obtained an additional 15 contacts. When I called "CQ this is N4ISS Special event station", everyone was anxiously waiting. Soon, I had quite a pile-up going, with DX into Canada, Mexico and Puerto Rico!

Just minutes after the second satellite pass, Fred showed up. Armed with a thermos of coffee, he was anticipating a long day ahead. I told Fred of the huge response I had on AO-27, and to expect the same on HF. Looking at the station clock, it was nearly our published operating time of 1500 UTC. I turned on my Yaesu FT-847 and tuned to 14.297 MHz. Fred was ready, with pen in hand. Hearing no one on the frequency, I keyed the mic and called "This is N4ISS, is this frequency in use?" With no reply, I called "CQ, CQ, CQ, this is special event station November 4 International Space Station, celebrating the manning of the ISS and arrival of STS-97 Endeavour Crew ... QRZ". Gene Alvis, W0ICY was the first to return my call. I told him about the mission and the purpose behind our special event. Then I invited him to visit our WWW site, at http://n4iss.homestead.com for more details. Clearing with Gene, the commotion on our frequency accelerated, as the word spread about our special event operation.

Fred and I were having a hard time picking out even partial callsigns, with so many stations calling at once. After a couple of hours, we were growing weary. I called fellow club members for reinforcement (Figure 1). We were both relieved, when Pete Theiler, KI4KN arrived. Now we were able to take a long deserved break. Pete tuned to 28.497 MHz., and began operation on 10 meters, because of the tremendous amount of QRM we were experiencing on 20 meters. Not long after Pete began calling CQ, he too, experienced

the overwhelming chorus of replies. Our special event's popularity was certainly "Out of this World!"

During our special event operation, we spoke with several of the participating ISS suffix stations. Chris Springer, W5ISS was the first, followed by Kent, W5OJ, who was operating a few kHz down from us. Kent showed tremendous support for our event by operating W5RRR from the Johnson Space Center ARC station, in Houston, Texas. We also spoke to Dave O'Neal, KD5ISS, who managed to participate, even though he was out of town on business. He was having a wonderful time operating mobile. Next we spoke with Jan Cox, KG4ISS assisted by her husband Ray Cox, KF4GCH. They were enjoying their first special event operation. Teaming up with several other ISS stations on 10 meters, they had quite a pileup going. Then we spoke to Patrick McGrane, K2ISS. He had been operating primarily on 10 meters, with excellent DX into Europe. We also spoke to Whitie Oriel, KA2ISS. There were reports of other *ISS-suffix* stations on the air, during the event. They included Cindy Loiero, K1ISS, assisted by her husband Paul Loiero, N1FI, Bob Grau, K3ISS, and Julie Stacey, N6ISS assisted by her husband Cleaon Stacey, N0LQN. As usual, Goddard Space Flight Center, did a fantastic job of operating their SAREX retransmission station WA3NAN during the entire STS-97 mission!

Reluctantly we decided to cease operation for the day. It was past dinner time, and an hour past our published operating time. We had worked 235 stations on HF, and another 17 on AO-27! Even though it was a lot of hard work, it was well worth the effort! We heard a lot of great stories, and received much praise for our special event. It definitely was a noteworthy cause. All of us thoroughly enjoyed the adventure and thrill of operating such a popular special event station! Before Fred and Pete departed, we discussed tomorrow's weather forecast. Unfortunately, there was an impending freak snowstorm predicted. It was doubtful that they could assist in Sunday' operation, if the roads were bad.

Feeling refreshed, after having dinner and a short nap, I resumed operating. I continued the N4ISS special event on satellite AO-10, starting at 0123 UTC. The old bird was doing a fantastic job, and I was able to contact 13 stations. As before, the special event again created havoc, with unbelievable pileups. This was mainly due to the interest in the ISS and STS-97 mission! However, South Carolina, being a rare state on the satellite, probably added a little to the excitement!

The next day, the snowstorm materialized. This left me as the lone operator to continue the special event. Like the day before, I began by first operating on AO-27. Then at 1500 UTC, I began operation on HF. When I called on 14.297 MHz, to see if the frequency was clear, I had quite a surprise! Keith, McNeal, N4ZO answered, stating that he and Bob Hayes, N1MIA were just waiting for me to show up! He said they had both tried to contact us yesterday, but couldn't get through the QRM. Clearing with them, the endless pile-ups again developed. Later that day, I was able to check into the Sunday International AMSAT net on 14.282 MHz. I worked net control Keith Pugh, W5IU; Steve Diggs, W4EPI; Ray Dudley, W8GQW; Brent Seebach, VE5SWL and backup net controller Larry Brown, W7LB! I hated to stop Sunday's HF operation, and disappoint the multitude of hams that were trying to get through. However, I was exhausted, having operated an hour past our scheduled time. That evening after resting, I operated DX on AO-10. This resulted in 32 more exciting contacts! Among the stations I spoke with, included Bdale Garbee, KB0G, who is one of the AO-40 RUDAK developers. I also spoke to Bruce Paige, KK5DO, and his 11 year-old daughter, Mahana Paige, W5BTS.

I decided to extend the special event operation, the following weekend. This would appease some of the disappointed hams that couldn't get through the pileups the previous weekend. Because of crowded band conditions on HF, I concentrated my operation on satellites. I operated 13 stations on A0-27 including Scott Medburg, KD5FBA/QRP, who was only using a HT! My AO-10 operation continued to have excellent results, with fantastic DX all the way into Europe!

All in all, during the N4ISS special event, I made 108 contacts on satellite AO-10. With QSO's in 31 states - AK, AZ, CA, CO, CT, IL, IN, KS, KY, MA, ME, MD, MI, MN, MO, NC, NE, NH, NJ, NY, OH, PA, SC, TN, TX, UT, VA, VT, WA, WI, WY and DX into 15 countries - Argentina, Austria, Belgium, Brazil, Denmark, England, France, Germany, Iceland, Italy, Netherlands, Portugal, Puerto Rico, Sweden, and 3 Canadian provinces Alberta, Ontario, Quebec. On satellite AO-27, I made a total of 47 contacts, with QSO's in 19 states - AZ, FL, IL, KS, LA, MD, ME, MI, MN, MO, MS, NH, NJ, OH, SC, TN, TX, VA, WI, and had DX into 3 countries - Mexico, Puerto Rico, and 2 Canadian provinces Nova Scotia and Ontario.

Our club was certainly amazed by the overwhelming interest in the STS-97/ISS mission. Which was apparent, by the over "One Thousand" Amateur Radio contacts, worldwide, that we, and the participating stations had made!

Among our contacts we spoke with some other very special stations:

• Wayne operating W7ASC from the Center for Amateur Radio Learning - located in the Arizona Science Center, Phoenix, AZ.

• John operating W3AA from the Franklin Institute Science Museum, in Philadelphia, PA

• Scott KT4PD operating WX4MLB during the NWS Special Event, from the National Weather Service Forecast Office, in Melbourne, Florida.

• Scott operating W4SVI Everglades ARC Special Event commemorating the dedication of the park by Harry S. Truman. Homestead, FL.

• Chuck operating N4WIS USS Wisconsin ARC Special Event, aboard the Battleship, while in route to the Nauticus National Maritime Center, VA.

The ISS Special Event operation was truly International. Between the participating ISS stations that we received logs from, and ourselves, the following were attained:

31 Countries:

Argentina, Australia, Austria, Balearic Island, Belgium, Brazil, Canada, Czech Republic, Denmark, El Salvador, England, France, Germany, Guyana, Iceland, Ireland, Italy, Jamaica, Mexico, Netherlands, New Zealand, Northern Ireland, Poland, Portugal, Puerto Rico, Scotland, Slovenia, Spain, St. Thomas Island, South Africa, Sweden.

9 Canadian Provinces:

Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Quebec, and Saskatchewan.

And 48 States:

AK, AL, AR, AZ, CA, CO, CT, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY, including Washington DC.

On Monday, 04 December 2000, the first of over 300 QSL's arrived. It wasn't long until my mailbox started to overflow with requests for our full color certificate. After receiving the logs from the participating ISS stations. I began to verify and enter the QSL informa-

tion. This resulted in over 500 labels, listing separate contacts, to go on the certificates.

I designed our full color certificate to compliment the wonderful Apollo 11's 25th Anniversary Certificate. The NASA Amateur Radio Clubs' Special Event issued it back in July 1994 (Figure 2). For the background I chose one of the beautiful photos the Endeavour crew took during its fly around, after undocking from the ISS. In the certificate's corners, I inserted the Expedition One crew and STS-97 mission patches. Inside the certificate's envelope, I enclosed a copy of "NASA Facts - Flight 2R: First Crew On the International Space Station".

We had a total of four winners for the ARISS tee shirt.

(A three-way tie of eight points each, and a late entry with ten points!)

• Jerry Keedy, AB5KP of Pine Bluff, AR, had a total of 10 points for working K1ISS, K2ISS, N4ISS, KD5ISS, N6ISS, W5RRR, and KG4ISS on 10 and 40 meters.

• Gerry Farmer, VE6GP of Calgary, Alberta, Canada, had a total of 8 points for working K1ISS, K2ISS, N4ISS, KG4ISS, KD5ISS, and W5RRR.

• Keith Brandt, WD9GET, McConnell AFB in Wichita, KS, had a total of 8 points for working K2ISS, W5ISS, W5RRR, and N4ISS on both AO-27 and 20 meters.

• Joe Thompson, W4CTH of Pawleys Island, SC, had a total of 8 points for working K2ISS, KG4ISS, W5RRR, and N4ISS on both AO-27 and 20 meters

N4ISS Station Equipment

Yaesu FT-847; Astron RS-70M power supply; Mirage B-1016G 160 watt 2-meter amplifier; RF concepts RGC4-310 100 watt 70 cm amplifier; GAP Challenger DX-VIII 80 through 2-meter vertical antenna; 10/15/20 meter 3-element tri-band antenna; KLM 2M-22C and KLM 435-40CX circular polarized satellite antennas. The satellite antennas are automatically controlled by NOVA satellite tracking software, in conjunction with the Kansas City Tracker/Tuner computer interface board, and a Yaesu G-5400B elevation-azimuth rotor.

QSO Summary

N4ISS via Fred WD4KTI, Pete KI4KN and Al KD4SFF had 426 contacts. We had 271 on HF, 47 contacts on AO-27 and 108 contacts on AO-10. We contacted stations in 44 states - AK, AL, AR, AZ, CA, CO, CT, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY, and had fantastic DX to 18 countries - Argentina, Austria, Balearic Island, Belgium, Brazil, Denmark, England, France, Germany, Iceland, Italy, Mexico, Netherlands, Portugal, Puerto Rico, St. Thomas Island, Sweden, and 7 Canadian provinces Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario, Quebec, and Saskatchewan.

N4ISS via Al KD4SFF had 108 contacts on satellite AO-10. With QSO's 31 states - AK, AZ, CA, CO, CT, IL, IN, KS, KY, MA, ME, MD, MI, MN, MO, NC, NE, NH, NJ, NY, OH, PA, SC, TN, TX, UT, VA, VT, WA, WI, WY and had fantastic DX into 15 countries - Argentina, Austria, Belgium, Brazil, Denmark, England, France, Germany, Iceland, Italy, Netherlands, Portugal, Puerto Rico, Sweden, and 3 Canadian provinces Alberta, Ontario, Quebec.

N4ISS via Al, KD4SFF had 47 contacts on satellite AO-27. With QSO's in 19 states - AZ, FL, IL, KS, LA, MD, ME, MI, MN, MO, MS, NH, NJ, OH, SC, TN, TX, VA, WI, and had DX to 3 countries - Mexico, Puerto Rico, and 2 Canadian provinces Nova Scotia and Ontario.

Cindy, K1ISS and Paul had 49 contacts to their credit, which included David, KD5ISS/M, Cleaon operating N6ISS. Ten meters was hot, and they were able to work stations in 20 states - AR, CA, CO, FL, IA, ID, KS, LA, MA, MI, MN, MO, MS, NE, NH, OH, TX, UT, WA, WI. They also had several fantastic DX contacts into 5 countries - Brazil, Guyana, Puerto Rico, South Africa and 4 Canadian provinces Alberta, Newfoundland, New Brunswick, and Ontario.

Patrick, K2ISS had 216 contacts, including Kent, W5RRR; Jan KG4ISS; Dave, KD5ISS/M and N4ISS. Pat even managed to work Dennis, 2E0AFI/QRP in Derbyshire, England, and Charles, W4VAC/QRP in Memphis, TN. Pat worked 30 states, mostly on 10 meters: AL, AR, CA, CO, CT, FL, HI, IA, ID, IL, IN, KS, KY, LA, MA, MI, MO, MN, MS, NM, NV, NY, OH, OK, SC, SD, TN, TX, WA, WI. And operated DX on 10 meters to 20 countries: Austria, Belgium, Czech Republic, Denmark, England, France, Germany, Ireland, Italy, Jamaica, Netherlands, Northern Ireland, Poland, Portugal, Puerto Rico, Scotland, Slovenia, South Africa, Spain and Canadian provinces: Alberta and British Columbia.

Whitie, KA2ISS had 13 contacts, which covered the states - IL, MA, MI, NY, NC, PA, SC, and 2 Canadian provinces New Brunswick and Ontario.

Bob, K3ISS had 24 contacts, which covered the states - AZ, CA, IA, KS, LA, MT, OK, SD, TX, UT, MO, WA, WI. He also had some great DX to England, Puerto Rico, and 2 Canadian provinces British Columbia and Manitoba

Jan, KG4ISS and Ray had 114 contacts, which included stations in 33 states - AR, AZ, CA, CO, CT, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, ME, MI, MO, MN, NC, NE, NH, NY, OH, OR, PA, SC, TN, TX, UT, VA, WA, WI, and DX to 6 countries - Australia, Brazil, Guyana, Puerto Rico, New Zealand and 3 Canadian provinces Alberta, Ontario, New Brunswick.

Dave, KD5ISS operating mobile, had a suprising179 contacts, which included stations in 33 states - AL, AZ, CA, CO, CT, FL, GA, IA, ID, IN, KS, KY LA, MA, MD, ME, MI, MN, MT, NC, NH, NJ, NY, OH, OR, PA, SC, SD, TX, UT, VA, WA, WV, including Washington, DC. And DX to 7 countries - Belgium, England, El Salvador, Mexico, Puerto Rico, Spain, and Canadian provinces: Alberta, British Columbia, Ontario and Quebec. David also worked Art "K4DQC" who was visiting the Kennedy Space Center in Florida!

Julie, N6ISS and Cleaon had 26 contacts, including Cindy K1ISS and Jan KG4ISS, with contacts in 11 states - AR, CA, FL, MA, ME, MD, NJ, NY, PA, RI, VA, and also Canadian province New Brunswick.

Kent operating W5RRR reported that he spoke to over 50 stations during the event!

We never would have guessed, that in just a years' time, that our clubs callsign, could be utilized in, and be so perfect for, such a noteworthy special event! It was an honor to participate, and we look forward to the wonderful adventures on board the International Space Station.

An infinite thanks to you all, for joining in our celebration of these galactic events!

Thanks & 73,

Experimenters Group ARC - N4ISS, c/o Al Lark, KD4SFF, 301 Shannon Dr., Greenville, SC 29615-1814, e-mail: *n4iss@amsat.org*, WWW site: *http://n4iss.homestead.com*

We would like to dedicate our N4ISS Special Event to the *Mir* Space Station Launched 20 February 1986 and de-orbited 23 March 2001. Her callsign R0MIR has brought much joy and peace to our world. She will always live on in our hearts, somewhat reborn, through the ISS. ■

Project Duckling - or - Uses for Dead Drakes.

Al Copland, GM1SXX

You've done the modifications, and find that nothing works any more. You've pulled all your remaining hair out, telephoned a friend, asked the audience, tried some voodoo and it's still caput. Try this recipe with the remains of your dead **Drake 2880.**

Recipe

Ingredients:

1 Dead Drake converter.

1 suitable crystal (see text)

Seasoning:

Connecting wire, scrap PCB, SMA 2 hole panel socket, fixing screws, 1000pF feed-through capacitor.

Method:

Take your DRAKE PCB out of the case and cut it with a bandsaw longwise right along the outer edge of the central groundplane (to the 'outside' of the PSU / OSC section). If you don't have access to a bandsaw, clamp the DRAKE PCB in a vice with the PSU / OSC section .. the part you want to keep .. protruding above the jaws and simply cut along the board using the top of the vice jaws as a cutting guide. You need to cut the PCB straight because you are going to seam solder it later. This is the most difficult part of the 'operation' and you should take great care to get a nice straight line. See the Figure 1 for details.

After sawing the boards in two, you will find that you have cut through two connecting wires on the underside of the PCB. Either rip off or unsolder the two wires that you just cut through. They are not needed.

Using a sharp knife or a Dremel® tool, trim back the two foils on the underside by 2mm. These two foils run across the groundplane to the edge you have just cut. This treatment avoids shorting the connections to the cabinet walls. Identify and treat the oscillator output foil (on the topside of the PCB) in a similar way but only remove 1mm of foil. The output foil runs parallel to the small metal screen and exits at the edge of the saw cut you just made.

Make a suitable cabinet from scrap PCB material. The board will sit in the PCB box and be soldered on two sides only. The cabinet should therefore be a bit oversize. I made mine 8cm long x 4cm wide x 3cm high. The board should be soldered in place along the sides containing (1) the regulators and (2) the output trace. See the Figure 1 of the completed unit for details. This layout doesn't really adhere to accepted microwave practices <grin> but in my defense I can only say that it works reliably. What it *does* do is to provide relatively easy access to the crystal. There is another reason for the strange cabinet design; some of the PCB foils on the topside go right to the edge of the board and would therefore short circuit to the groundplane if a tight fitting cabinet was used. You are probably wondering what to do to heatsink the regulators. I never bothered to use any heatsinking because I found that the regulators were at a comfortable temperature when running from a +13.8V supply. The power consumption of the modified Drake is around 80ma at 13.8V, nearly half of that of a complete Drake unit.

If you are worried about damaging the unsupported part of the board beside the crystal, you could always use some thick copper foil or shim to make a small support bracket. I didn't because the board seemed rigid enough to me and I've swapped a pile of crystals

Project Duckling

Fit an SMA panel connector positioned to mate accurately with the oscillator output lead. The oscillator output lead should mate straight onto the SMA center pin and be soldered in place. You can see the arrangement in Figure 2. Model shops are a good source of the small bolts needed to fix these connectors in place. Cut the bolts down to the correct length so as not to short-circuit anything on the PCB. Fit a 1000pF feed-through in the case side, close to the reverse polarity protection diode and run a wire from the feed-through to the diode. Fit a suitable crystal.

Apply 13.8V and check that you get RF output. Adjust the netting trimmer until you are happy with the output frequency.

That's it!

The *moral* of this story: ***Half a duck (Drake) is better than none!***

(Just let me do the funnies in future ..... LA2QAA)

How Does It Perform?

Figure 2 shows the Duckling connected to a DIY 50R terminated diode probe. Note the gap on two edges of the PCB. This avoids short-circuiting of some of the topside foils while allowing reasonable access to the crystal. I've been playing with my new SHF source. Lets see what it can do. First I checked it out with a pukka crystal a la original DRAKE modification (8.8125MHz) that of course provides RF out on 2256 MHz. Fine. That worked as advertised.

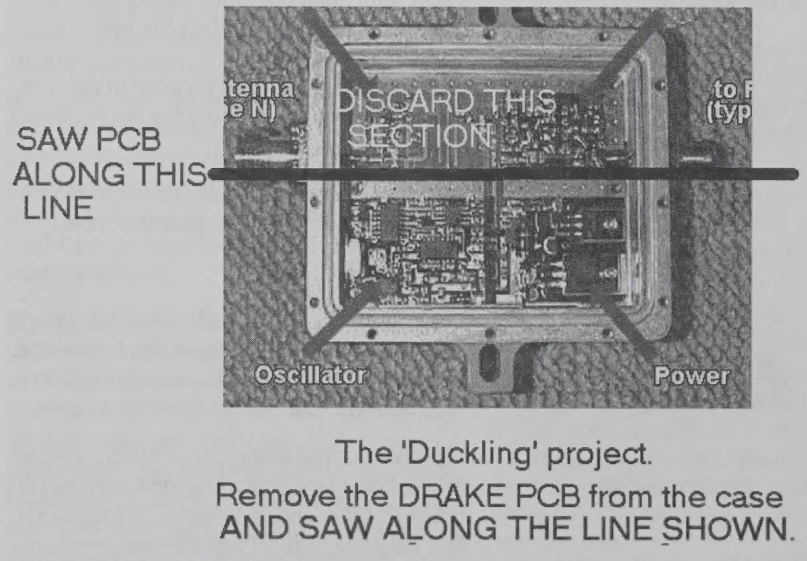

Figure 1. This photograph shows where to cut the PCB after removal from the case. Ignore the large black arrows as I borrowed this photo from a well visited webpage. The RF output trace runs across the central groundplane section parallel with, and just to the right of the small metal screen.

I found several other crystals in my junkbox that are mostly communications types from computers.

An 8.89843 MHz one was fitted and the output was 2278 MHz. I also tried a crystal for 7.6953125 MHz. That gives an output on 1970 MHz. This could be used as a local oscillator, with an outboard mixer, to mix the 13 cms band down to 430 MHz.

This oscillator unit makes a perfect high stability, low cost source for testing good Drakes. What could be better? In general, I could shift the frequency + &- 75 kHz with the netting trimmer. None of this stuff had actually cost me a bean. The Drake I used was a scrapper that had been *got at* by a previous owner and was only being kept for components.

So, now I know that the oscillator will certainly tune over the range 1970 – 2278 MHz. A *huge* tuning range. Very versatile indeed!

Incidentally, if ordering a crystal for the Duckling, it should be specified for a 15pF load. Crystals for other load capacitance values, such as 30pF types will shift the output frequency somewhat.

I have not tried getting the Duckling to work above 2278 MHz but I have no doubt that its possible. My only excuse for not testing my theory is that I do not have a big junkbox full of LF crystals. Since it works down to 1970 MHz, I would be **very** surprised if it did not work at frequencies higher than I've tried to date (2.278 GHz). This is one flexible and forgiving oscillator. For a 2401MHz source, try a 9.37890625 MHz rock. For a specific frequency, take the frequency you want and divide by 256. If you have any crystals in the range 9.375 to 9.3828125 MHz in your junkbox, use them. They should make a useful 2.4 GHz test source to produce RF output in the range 2400 to 2402 MHz.

In Figure 2, you can see one of my *high tech* terminated diode probes connected to the LO output. With this simple probe, I measured 0.7V DC output into a 50R load on my DVM. That's 10mW or +10dBm. I do not have access to professional test gear and have to *make do*, in the time-honored method of the *hands-on* type radio ham. This sort of output power level is very useful for a local oscillator.

By just cutting the ruined Drake board in half and ripping off the two unwanted supply wires on the underside, I have a very versatile little source. Judging by what I've seen and heard, there must be lots of dead Drakes out there just waiting for this *GM1SXX conversion* to something more useful. Being a canny Scot, it delights me to make useful stuff out of junk. And lets face it, it's *a lot* cheaper than buying a commercial source. I wish I had a wheelbarrow load of dead Drakes. Even dead ones are very versatile things indeed.

Now, I'm wondering if the Duckling could be used to mix the incoming signal from Meteosat on 1691 MHz down to 137-138 MHz. I'd need a local oscillator on 1555MHz ((1691-136)/256)MHz. That's 1555/256 or 6.07421875 MHz. I don't have a crystal that's even close to this in the junkbox but I'm tempted to order one, just to test my theory.

Uses for the Duckling

The first use I thought of for this project was simply as a good quality *alignment aid* for setting up other Drake 2880's. Then I had another thought in that followed by a 4x multiplier, it could make a useful 10 GHz beacon. It could also be used as a local oscillator for a DIY 13cms TX or RX strip. The output power level is perfect for this sort of application. I'm sure you'll be able to think of many more uses for this versatile little gizmo. As a inexpensive, stable and reliable 2.4 GHz oscillator, it's really hard to beat. Almost worth buying a shiny new Drake just to butcher it for the oscillator. (Cringe!.. LA2QAA)

Other Waffle

You'll probably be dismayed to learn that all my PCB *project boxes* are in natural *shiny copper* or shiny *green fiberglass* finishes and I just can't support this LA2QAA theory that *black is best*. The most treatment they ever get is a sprayed coating of *clear conformal lacquer* to stop the copper going *verdigris green*. Mouldy green is not generally regarded as the most attractive of finishes. It's a long time indeed since I actually bought a cabinet for a DIY project.

Inexpensive 23cm Power Divider

Recently, I found some particularly nice *algae green* fiberglass board at work. Not being photo-resistant coated, the electronics people didn't have a clue how to make use of it. Perhaps they haven't heard of indelible markers! This is why my new DIY 23cm power divider is made from some strips of the stuff sized to suit a bit of copper microbore heating pipe I had lying around in the shack. The outer square section of the divider was fabricated from the PCB and I took the numbers for it straight out of the *Radio Communication Handbook*. I fitted it with BNC panel mount connectors and soldered it all together. And very nice it looks too. Oh, and it also works pretty well. Always a plus point is that! The *algae green* PCB is the sort of stuff that doesn't bend, ruins saw blades and makes a loud *clang* like sheet metal when dropped. Very dense stuff indeed. (Just like Al's brain ... LA2QAA).

This PCB is way too good to be wasted on our electronics people. For them, DC really **does** mean DC and not 1.3 or 2.4 GHz!

'Til the next time. 73, Al

(*gm1sxx@amsat.org*) ■

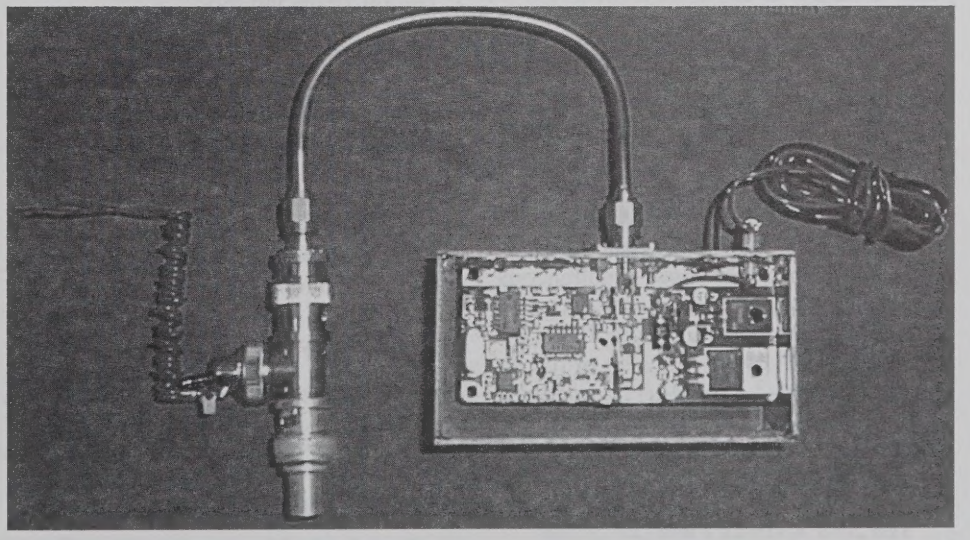

Figure 2 shows the Duckling connected to a DIY 50R terminated diode probe. Note the gap on two edges of the PCB. This avoids short-circuiting of some of the topside foils while allowing reasonable access to the crystal.

2001 AMSAT Field Day Competition

Andy MacAllister, W5ACM

It's that time of year again; summer and Field Day! Each year the ARRL sponsors Field Day as an emergency preparedness exercise. The event takes place during a 24-hour period on the fourth weekend of June. For 2001 the event starts at 1800 UTC on 23 June 2001 and continues until 2100 UTC on 24 June 2001. AMSAT promotes its own version of Field Day for operation via the HAMSATS, held concurrently with the ARRL event.

If you are considering **only** the FM voice satellites like UO-14 or AO-27 for your HAMSAT Field Day focus, don't, unless you are simply hoping to make one contact for the ARRL rules bonus points. The congestion on UO-14 and AO-27 was so intense in 2000 that some stations running over 100 Watts on the two-meter uplink to high-gain Yagi antennas couldn't make a single contact. A few extremely well equipped stations dominated the field and made it virtually impossible for those with small antennas and reasonable power levels to get through. **The newly modified AMSAT rules now only allow ONE contact per each FM, single-channel satellite.** Although it is doubtful that those stations with dual-band HTs using simple whip antennas will get through even with the new rule, it is hoped that more folks will at least get a chance to make a contact. Stations that have completed their single contact via a particular FM satellite, are encouraged not to make any further contacts via that satellite during the Field Day period, even if they are not participating in the AMSAT event. Diversify and gear up for other voice/CW or digital HAMSATS.

If you have worked the satellites on Field Day in recent years, you may have noticed that a lot of good contacts can be made on some of the less-populated, low-earth-orbit satellites like FO-20, FO-29 and RS-12/13. During Field Day the transponders come alive like 20 meters on a weekend. The good news is that the transponders on these satellites will support multiple simultaneous contacts. The bad news is that you can't use FM, just low duty-cycle modes like SSB and CW. AO-10 can also be a lot of fun on Field Day if the solar panels are properly illuminated and it is in a good position in the sky for Field Day. Plot some orbits and check it out.

The 2001 AMSAT Field Day Rules

The AMSAT Field Day 2001 event is open to all Amateur Radio operators. U.S. and Canadian amateurs are to exchange ARRL section and Field Day transmitter class. Foreign amateurs should exchange country name and signal reports. The AMSAT competition is to encourage the use of all amateur satellites, both analog and digital. **Note that no points will be credited for any contacts beyond the ONE allowed via each single-channel FM satellite. Operators are encouraged not to make any extra contacts via theses satellites (Ex: UO-14 & AO-27).** CW contacts and digital contacts are worth three points as outlined below.

1. Analog Transponders

• Each satellite transponder is considered a separate band.

• All phone QSO's and all CW QSO's on a given satellite transponder are considered separate bands.

• All packet/RTTY/ASCII/AMTOR QSO's through analog transponders are counted as CW QSO's.

• Phone QSO's count for one point and CW QSO's count for three points.

• Cross-mode (CW/phone) contacts are not allowed.

• Only one contact is allowed via each single-channel FM satellite.

• The use of more than one transmitter at the same time on a single satellite transponder is prohibited.

2. Digital Transponders

For the Pacsats (LO-19, UO-22, etc.), each satellite is considered a separate band. Do not post "CQ" messages. Simply upload **one** greeting message to each satellite and download as many greeting messages as possible from each satellite. The subject of the uploaded file should be posted as Field Day Greetings, addressed to ALL. The purpose of this portion of the competition is to demonstrate digital satellite communications to other Field Day participants and observers.

The following uploads and downloads count as three-point digital contacts.

(a) Upload of a satellite Field Day Greetings file (one per satellite).

(b) Download of Satellite Field Day Greetings files posted by other stations. Downloads of non-Field Day files or messages not addressed to ALL are not to be counted for the event. Save DIR listings and message files for later "proof of contact".

Satellite digipeat QSO's and APRS short-message contacts are worth three points each, but must be complete verified two-way exchanges.

The use of terrestrial gateway stations to uplink/downlink is not allowed.

Contacts with the International Space Station (any mode) are not counted for AMSAT Field Day operations, even if available.

If FO-29 is active, the JA transponder can be used for analog CW and phone activities under the analog transponder rules, and the JD system can be used as a separate transponder under the digital rules.

Sample Satellite Field Day Greetings File

Greetings from N5EM Field Day Satellite station near Katy, Texas with 20 participants, operating class 2A, in the AMSAT-Houston group with the Houston Amateur Television Society and the Houston QRP club. All the best and 73!

Note that the message stated the call, name of the group, operating class, where they were located (the grid square would be helpful) and how many operators were in attendance.

3. Operating Class

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power. On the report form simply check off Emergency or Commercial for the Power Source and be sure to specify your ARRL operating class (2A, 1C, etc.).

And Finally...

The Satellite Summary Sheet should be used for submission of the AMSAT Field Day competition results to Andy MacAllister, W5ACM, Vice President User Services, 14714 Knights Way Drive, Houston, TX 77083-5640. Make sure to also send your Field Day photographs with your submission! The deadline for submissions is August 1, 2001. You can also send your entry sheet and digital photos via e-mail to *andrew.macallister@daniel.com.*

The first-place emergency power/portable station will receive a plaque at the AMSAT Annual Meeting and Space Symposium in

Atlanta, Georgia, on 5-6 October 2001. Certificates will be awarded for second and third place portable/emergency operation in addition to a certificate for the first-place home station running on emergency power. Stations submitting high, award-winning scores will be requested to send in dupe sheets for analog contacts and message listings for digital downloads.

You may have multiple rig difficulties, antenna failures, computer glitches, generator disasters, tropical storms, and there may even be satellite problems, but the goal is to test your ability to operate in an emergency situation. Try different gear. Demonstrate satellite operations to hams that don't even know that the HAMSATS exist. Test your equipment, avoid making more than ONE contact via the FM-only voice HAMSATS, and enjoy the event! ■

AMSAT Satellite Summary Sheet - 2001

Submit to Andy MacAllister, W5ACM

Analog Satellite Operation

Satellite/Mode	CW QSO's	Phone QSO's
Multiplier	x 3	x 1
Analog Subtotals		

Digital Satellite Operation

Satellite	Upload/Downloads
Multiplier	x 3
Digital Subtotal	

Score Calculation

Analog CW Subtotal (above)	
Analog Phone Subtotal (above)	
Digital Subtotal (above)	
GRAND TOTAL	

Your Field Day Callsign_____

Your Group Name_____

ARRL Field Day Classification_____**Section**_____

Power Source: Emergency_____**Commercial**_____

Your name and home call_____

Comments_____

Kenwood TS-2000, A Satellite Operator's Perspective

Jerry Brown, K5OE

This is the best radio that needs improvement I have ever operated. What do I mean? This radio is so good at doing so many things, that I just can't help but want it to do more and do it better. It's not perfect, but I can't help but feel it could be—with just a few simple tweaks. Here are my observations after spending a month with this new all-mode 160 m to 23 cm radio, with some recommendations on how to improve this already impressive radio.

Firstly, let me say the rig is larger and heavier (almost 8 kg) than I expected. I would have preferred it not be so deep, but the form factor was probably determined based on mobile bracket size requirements (same as previous Kenwood rigs). Its high-tech look is deceiving, as it is a solidly built and substantial piece of equipment. The main display has brightness control from too-dim to it-hurts-my-eyes. I found it most comfortable at the default setting, but realize the other extremes would be useful in a tent at night or in bright sunlight. The backlit keys are a nice touch; evoking memories of the warm glow of tubes inside the radio. The fan does not run full-time and is pleasantly quiet compared to other radios I own.

The features built into the TS-2000 are what make it a joy to operate. The rig has three HF antenna ports (one is receive only), and separate 2 m, 70 cm, and 23 cm antenna ports. The satellite mode (SAT) accommodates combination of any two ports. Separate CW key and paddle jacks are provided on the back (yes!) as well as separate phone jacks for the main and sub-VFO's. The front panel phone jack can be configured to be either VFO, a mix of the two VFO's, or stereo—one in each ear.

Ten satellite memories are provided in addition to the 300 regular memories and the *quick* memories. The SAT mode is entered with one-button touch and automatic tracking, called TRACE, is also enabled with one button (direct or reverse). Satellite memories recall both VFOs' default frequencies, modes, and name, but I wish more data was stored in the memories (see later comments). Alphanumeric tag names can be configured, such as "AO-40U/S." All the usual memory features are available and straightforward to use. The "A/B" key swaps the VFO's between the main and sub-band display, but does not change which one is the uplink and downlink. This is quite handy at times when it is more convenient to use the main VFO dial for manually tuning the uplink, such as when you are trying to find your downlink on AO-10.

The TRACE tracking feature is especially sophisticated. Since both the A VFO (downlink frequency) and the B VFO (uplink frequency) are displayed, it is easy to see the changes made to the uplink VFO while tuning the downlink VFO. What's unique, however, is tuning of the uplink VFO does not move the downlink VFO. This allows you to compensate for Doppler shift on transmit without having to take the rig out of TRACE mode. Try this on FO-20 or AO-10 when in the middle of a ragchew and you will be hooked!

Several non-satellite-specific features are worth mentioning as well. The HF auto-tuner is fast, if not particularly quiet (remember when they used to hum instead of clicking), and can be used in receive mode. This helps reduce the noise floor of the receiver, acting as an inline bandpass filter. I use this feature for the RS-12/13 downlink. Some of the CW features are useful as well, particularly a SSB-to-CW offset option that aligns your receive frequency when going from one mode to the other (another slick operating aide for AO-10 and FO-20). There is also a very handy auto-CW option that automatically puts you in CW mode if you touch your paddles (while you are in SSB), but, unfortunately, this option does not seem to function in SAT or SPLIT modes. The TRANSVERTER option allows the display to be mapped to a different frequency and it also limits the outputs to minimum power. This power limiting "feature" is a problem since it will not allow me to use my Drake 2880 with the convenient 2401.350 MHz display option, AND also have full power out on 435 MHz (mode U/S) or 1.2 GHz (mode (L/S). Besides the usual linear keying relay, there are separate EXT contacts for the PTT for the 50, 144, 430, and 1,200 MHz bands—very nice for sequencing amplifiers and protecting receive preamps and converters.

I found the sub-receiver (V/UHF AM/FM) handy for monitoring a satellite downlink frequency while busy on HF. When the bird's downlink breaks the squelch on the sub-receiver, you are only one button push away (the big SAT button) from talking in full-duplex satellite mode.

The receiver aids are flexible and intuitive. The IF DSP controls are handy, with the IF filter low-cut and high-cut (SSB) control knobs and graphic display right on the front panel. For CW operation, these knobs automatically change to passband width and frequency offset. Front panel controls also select the built-in AF DSP functions for phone and CW, which are, of course, configurable. Both receivers have RIT and the AGC controls go from "off" to "fast" in 21 timing settings, plus "auto" based on mode. The receive audio can be tailored to one of several predefined shapes, or can be user-configured. The automatic notch filter, the manually-adjustable notch filter (called Beat Cancel), and CW Auto Tune work like magic. I found the HF audio to be very pleasant, even *warm* to listen to, but the VHF/UHF audio from satellite downlinks requires the use of the built-in preamplifier. This preamp, when used in conjunction with my mast-mounted 70 cm preamp, produces a noise level I found a little tiring without cutting back on RF gain. When satellite signal strengths are suitable for invoking the AF DSP, this effect is greatly reduced. One final note on the receiver: there is an "internal beat" produced at 436.799 MHz that obliterates the middle portion of AO-27's downlink. Correspondence with Kenwood has not yet resolved how to fix this unfortunate design oversight.

Transmit aids include the usual mic and speech processor gain, but also include VOX, transmit audio *shaped* similarly to the receive profiles, a built-in TX-Monitor, configurable IF filter bandwidth, an SWR/ALC/PWR meter (SWR on HF+6m only, unfortunately), and adjustable power output available on the front panel. There is a separate menu option for FM mic gain. I had some initial difficulty getting good audio reports on the satellites. This isn't surprising considering the large number of options available and the ability to completely distort your own audio with these controls if improperly applied. I eventually settled on the bass-boost shaping option, the speech processor turned down to 25 percent, and the mic gain set at the default 50 percent. I use a Heil HC-5 boom microphone. The CW and voice memory keyer are easy, taking mere seconds to set up and use. The voice keyer sounds perfectly natural when listening on full duplex satellites.

The simple, direct RS-232 serial interface to my computer was a breath of fresh air. I wish all radios had this interface! When commu-

Kenwood TS2000 (courtesy of Kenwood Corporation)

nicating with a computer program, a "PC" shows up on the radio's display; a nice touch. The built-in TNC operates 1200 baud AFSK and 9600 baud PSK with a flexible set of configurable options. I used both the main and the sub-receiver to collect some local packets, including DX spots: the DX call is displayed on the panel and announced in CW, a really cool feature! It downloaded the directory and files (9600 PSK) from UO-22 using both PB and WISP with the plug-and-play settings. There are also external TNC connections available via the ACC2 jack. There is no FM discriminator meter, but using the S-meter proved more than adequate. I have not tested the SCAN features or the Sky Command II (remote control via an HT or other V/UHF radio). It receives PSK31 like a champ, but I did not test any of the other digital modes: RTTY, AMTOR, SSTV, etc.

In summary, this is a fantastic HF radio, with great receiver/DSP performance and every feature I have ever wanted (many more that I did not mention), **and** is also a competent satellite rig. It's initial price may look steep, but when one considers it is both an HF rig and a satellite rig, has 1.2 GHz capability (optional), has a built-in tuner, TNC, PC-interface, TXCO, and memory keyer (voice optional), and has IF-DSP, it starts to look attractive. Not having to switch headphones, mic, CW key, and foot switch when going from FO-20 to RS-12 is just about worth it all by itself. What would I change? There are several improvements that would make this a much better, even perfect, satellite radio:

- More satellite memories. Each AO-40 mode combination will need it's own memory.

- Make the TRANSVERTER power limiting *feature* optional (for mode U/S with a receive downconverter).

- Make some of the MENU options storable in memory, such as RX ANT, TRANSVERTER, TNC options, TX INHIBIT, and most importantly, the PWR setting.

- Improve the gain/NF of the receiver at V/UHF so the preamp is not needed all the time. It is not needed for HF and 6 m.

- Remove/move the internal *beat* at 436.799 MHz.

- Add SWR functionality to the meter on V/U/L bands. FM discriminator would be nice too.

- Move the *CTRL* and *1 MHz* keys to above the VFO knob. These are hard to reach and the CTRL key is used often in full-duplex satellite operation.

- Move the *MAN BC* closer to the other DSP controls.

- Add APRS functionality to the built-in TNC.

This is, like other recent Kenwood rigs, a software upgradeable machine, so I have hopes some of my wishes will be granted in the future. I wonder if, one of these days, I can download an upgrade via the Internet and load it through that handy RS-232 link?

Finally, a few things Kenwood did extremely well are also worth mentioning. The announcement of mode change in CW (C, U, L, F, A, K) is surprisingly helpful. The CW autobeat and the TF-SET (allows you to listen to transmit frequency) worked well and are handy operating features. The layout of the panel is excellent for one-handed operation, with the exceptions noted above. Just push the big "SAT" button to enter SAT mode and just push the "VFO/M" button to access the stored full-duplex memory configurations (with alphanumeric names) for each satellite. The manual is well written and comprehensive, with lots of cross-referencing. The manual is available online at:

http://www.kenwood.net/products/index.cfm?AMA=open&ama_bstat=open&radio=TS-2000&selection=Amateur. ■

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ATOS
The Phase 3D Satellite's Orbital Path Propulsion Regulating System

Dieter Zube, The Technical Institute for Thermodynamics and Technical Structure Equipment, Technical University Dresden and Ernest Messerschmid, DG2KM, Institute for Space Travel Systems, Stuttgart University

Translation: John J. Bubbers, W1GYD

Editor's Note: This article originally appeared in the AMSAT-DL Journal *before the launch of Phase 3D/AO-40 in November 2000. The article describes how AO-40/Phase 3D will be the first satellite in the world to use a thermal arc propulsion system (arcjet) for orbital path adjustment, in addition to many other unusual technical concepts. This article presents the propulsion system and its operational function.*

Why use an Arcjet on Phase 3D?

In satellite technology one is interested in achieving the highest possible exit velocity of the propulsion gases, in order to use the available fuel optimally. Thus with greater exit gas velocity a greater useful life is achieved in space for a like amount of fuel. Since the 1940's, electrical space travel propulsion systems have been studied and developed in which the exit velocities have been increased by the introduction of electrical energy. The so-called thermal *Lichtbogentriebwerke* (plasma propulsion engine) belongs to those drives to which additional energy is added by a continuously ignited electrical arc in the propulsion gas; it is called an *arcjet* in English.

At the first orbital path proposal for Phase 3D it became clear, based on the great eccentricity and the high inclination requirements, that there would be a relatively large propulsion requirement in order to reach the planned orbit, and for another, to be able to stabilize the path sufficiently accurately. After the system optimization showed that the arcjet had advantages over ionization propulsion systems for Phase 3D because of its smaller system mass, Dr. Meinzer turned to Professor Dr. E. Messerschmid (German astronaut and DG2KM) at the Institute for Space Travel Systems (IRS) at Stuttgart University, where work has been done in the laboratory development of electrical propulsion systems since the 1970's. After the establishment of the parameters such as fuel quantity, available electrical power, and qualification requirements it turned out that for Phase 3D an arcjet in the 750-Watt class with ammonia (NH_3) as the fuel would be appropriate.

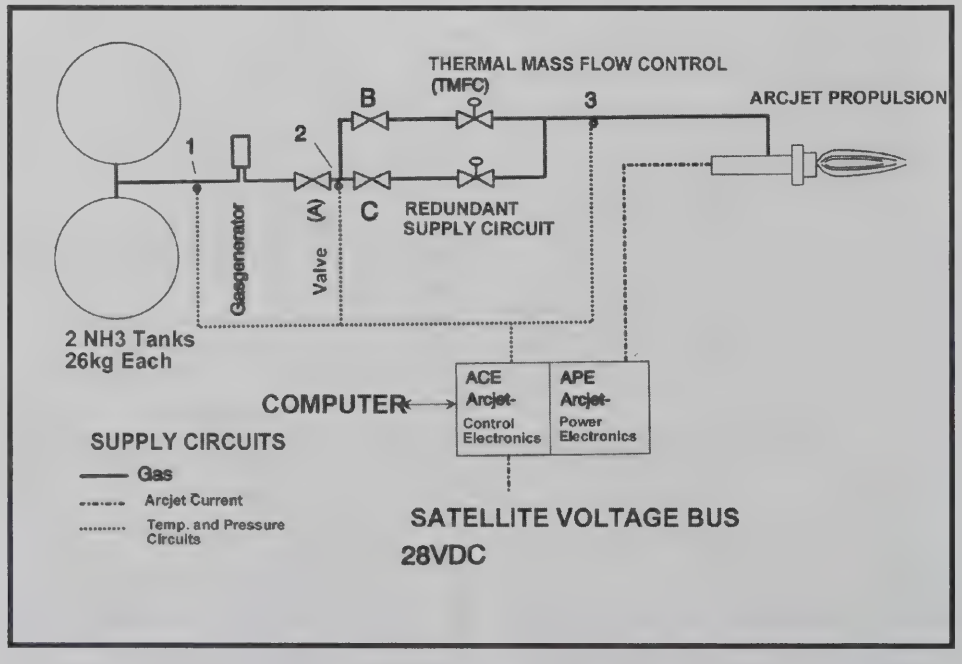

Figure 1. The ATOS Arcjet engine system

ATOS has been under development since 1992; this abbreviation stands for *Arcjet Triebwerk auf OSCAR-Satelliten* (arcjet propulsion system on OSCAR satellites). The assignment of the tasks between the Institute for Space Travel Systems (IRS) and AMSAT is such that IRS covers all the work on the fuel and the fuel supply system and its allied components, while AMSAT-DL (Dr. Meinzer) covers the power supply and the control electronics for all of the system components as well as the interface to the satellite's on-board computer. DARA and the Office of the Saxonian Minister for Science and Arts financed the development of ATOS.

System Description

Figure 1 presents an overview of the complete system. It is comprised of three major components:

- the actual propulsion system
- the necessary current supply required by the propulsion system
- the fuel supply system.

Propulsion System

A brief description of the procedures in the arcjet (Figure 2) follows: The *satellite warmed* propulsion gas arrives at the arcjet at about 15°C, and serves simultaneously to cool the housing while flowing into the combustion chamber of the propulsion system at about 600°C. Between the tip of the cathode and the jet body, which serves as the anode, there is an electrical arc in which the gas is heated. A temperature of greater than 15,000°K is achieved in the core of the arcjet, which is next expanded in the jet housing and produces the thrust for the satellite.

However, not all of the electrical energy can be converted into thrust energy. Loss is introduced in the ionization and dissociation of the ammonia as well as the radiational cooling of the hot propulsion system. The exhaust gases of an ammonia arcjet are hy-

drogen and nitrogen atoms as well as ammonia molecules.

Figure 3 shows the engineering model of the ATOS propulsion system in operation with the typical arcjet plasma beam. The system has a larger diameter in the jet region in order to achieve the most cooling by jet output, which is the only possibility for cooling in space. The electrical energy is fed into the rear end of the propulsion system, and the fuel input feed is approximately in the center of the system. The materials for the propulsion motor are high temperature alloys. High temperature ceramics on the inside serve as insulation between the cathode rod and the housing that conducts the anode voltage.

The completed propulsion unit weighs about 500 grams and is 250 mm long. In laboratory tests at IRS the thrust unit was measured on a thrust measurement bench, from which the typical operating values are shown in Table 1, which will also serve the control stations in doing their computations. In the meantime, an engineering model was driven for 670 hours in laboratory tests, which corresponds to the expected Phase 3D operating life. All tested components that will be used in the flight withstood the tests in satisfactory condition, and there is no longer any problem in the way of installing ATOS on the satellite.

Current Supply Unit

As mentioned in the description of the propulsion unit, a plasma will be generated in the arcjet, which has a specific current requirement. It has been shown that a reliable arcjet operation must be supplied with constant current. The plasma voltage requirement depends on the demands of the plasma. Since the plasma has a "negative current vs. voltage characteristic", i. e. the voltage of the plasma falls with increased current, and which is subject to variations, so an appropriate supply module for the ATOS system was built by Dr. Meinzer, which provided the required currents for the arcjet's operation.

This module (Fig. 4) presents a large challenge for both the power demand and also for weight. The unit operates at a switching frequency of 100 kHz, achieves an operating angle of 92°, and weighs 2 kg. At the same time the module houses the ignition electronics; the ignition voltage is coupled into the arcjet current circuit by a coil. The plasma is ignited by a voltage pulse of 3 kV between the cathode's tip and the anode. After successful voltage breakdown the current regulator takes over the current regulation. The removal of the heat losses of about 60 W is achieved by the placement of the unit on a heat sink in contact with warming tubes.

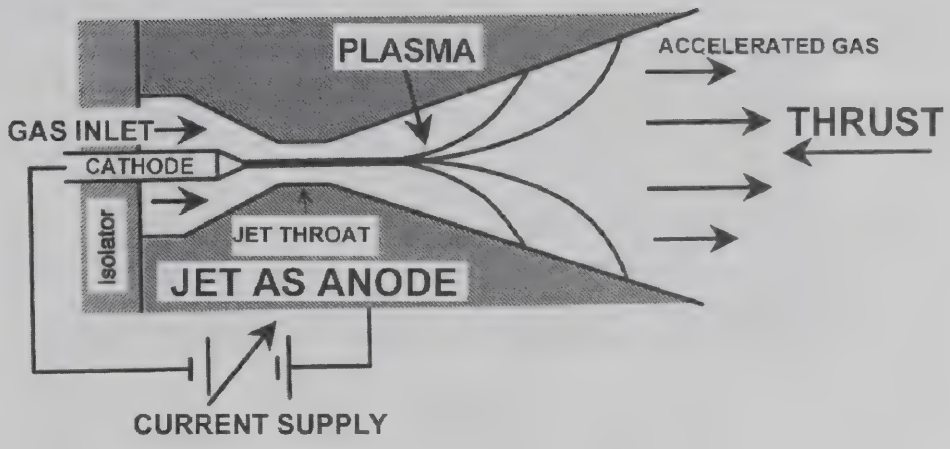

Figure 2. A sketch of the stages in the arcjet engine

The flight unit will also receive the system control-regulation, in addition to providing for the arcjet. This will include the control of the valves and of the gas pre-heaters as well as the data evaluation of the system measurement points for current, voltage and pressure circuits. The on-board computer will indicate only the ignition and the appropriate turn-off point; everything else will be done by the control-regulator unit. The data exchange between ATOS and the on-board computer will be kept at a minimum to not overload the telemetry; only in the event of trouble would more data be transmitted.

Fuel Supply Unit

Arcjets are dependent upon a minimum amount of gas fuel flow through the combustion chamber. Otherwise, the plasma will be unstable and damages to the propulsion engine could occur. Additionally, the arcjet is relatively sensitive to variations in the flow during the ignition phase, which is why they are generally fed by constant volume flow and not by constant supply pressure. Shortly after ignition the engine's input pressure increases; if the propulsion engine were fed with constant pressure, the ignition of the massive gas stream would be too large, and the plasma could be extinguished. For that reason the so-called thermal mass flow controllers (TMFC) are used which measures only the volumetric amount of gas and can also actively regulate the flow. These devices have not yet been tested in space, however, which is why a redundant device has been included to reduce the failure possibility.

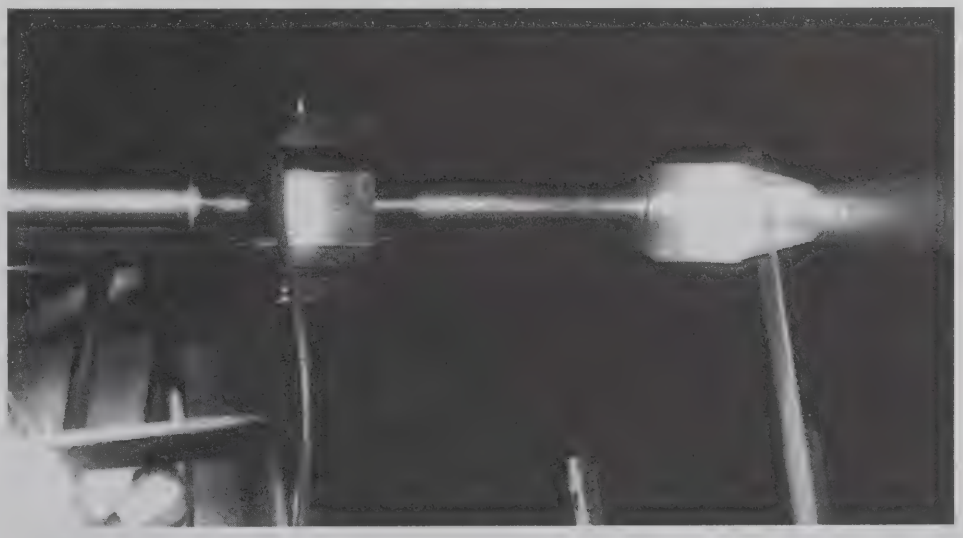

Figure 3. Engineering model of the ATOS engine in test operation on the thrust test bench. On the right hand side of the picture is the glowing jet with the plasma trail, and on the lower edge of the picture is the gas and current supply and the engine mounting.

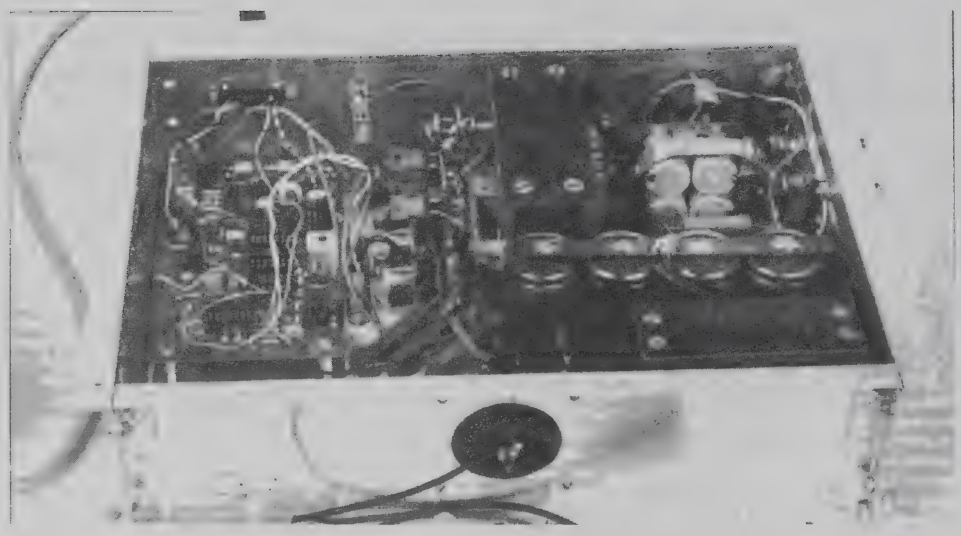

Figure 4. The prototype of the arcjet current supply (without the system control electronics - housing cover removed). This device has already operated in the test operation for 1,000 hours.

The ammonia is a gas-fluid mixture at the on-board temperatures, at a pressure of about 7 bars. The thermal mass flow regulators and the arcjet should be fed with ammonia in the form of gas. There is the additional condition because of the loss of gravity on board the satellite the ammonia from the tanks is not singularly defined. Therefore, at the connection from the tank output there is an ammonia evaporator, which is electrically heated and insures that there is only gaseous ammonia in the feed line. This gas generator was built by a company in Moscow, which has had many years of experience in the operation of pressurized gaseous ammonia propulsion units.

Phase 3D Operation

An accurate determination of the operation times and duration is not possible before the launch, since they will be dependent upon the actual orbital path parameters. The two ammonia tanks of about 52-kg on board Phase 3D permit the guidance. With it, 660 hours of nominal operation are available. The main task of the ATOS is the fine-tuning of the attitude inclination and its periodic implementation. The earliest ignition of ATOS will be after reaching an orbit with a 16 hour period and an inclination of 60°; individual ignitions would follow, so that the Phase 3D final orbit will reach its final path through a combination of propulsion engine ignitions and drift periods. In normal events, this would mean that ATOS would be set into operation at times for one hour every two to three days.

Once Phase 3D is launched and the ignition of the 400-N Engine and the arcjet have been performed, it should be possible to regulate the orbit of the satellite for four or five years by using ATOS. Then the ammonia supply will have been depleted and Phase 3D would be rendered helpless to disturbances in the orbital path, i. e. disturbing events could not be corrected and Phase 3D would slowly drift away from its ideal orbital path, as did most of the amateur satellites before it.

The battery capacity can supply the propulsion unit at times for approximately one hour in normal operation. Should the battery capacity be drained because of operational requirements of the propulsion system, the resource management of the on-board computer would cause an early ignition shutdown. This is not critical in relation to the effectiveness of the drive, which upon increased power requirement the thrust level and the exit velocity are increased and there is no fuel or energy wasted.

Transponder radio communications will not be possible during the operation of the arcjet because of the large energy demands. The potential problem of electro-magnetic interference from the ATOS propulsion system also came up. Meanwhile, American tests on arcjets have shown that arcjets do not radiate any kind of interference in the typical frequency bands used by fixed satellite communications.

To be sure, the success of the entire mission depends on the reliable operation of ATOS, but we also feel, that the previous and yet to be performed laboratory tests with an improved propulsion engine system carries the thought that ATOS is space qualified, and demonstrates that after decades of laboratory operations, arcjets are sufficiently mature to be used in operational missions. And we hope that ATOS can demonstrate that the design philosophy of Amateur Radio satellites, the fun of experimentation, their determination and that the propulsion system technology is applicable to space travel. It should also be possible to show that the technical colleges and universities are able to make meaningful satellite components. If the acceptance of arcjets should also succeed in increasing applications other than simple attitude adjustment of satellites, then ATOS will have fully and completely achieved its purpose. For this we will keep all available fingers crossed. ■

Electrical Power Consumption	**750 W**
Plasma Current	**8.5 A**
Plasma Voltage	**88 V**
Thrust	**95 mN**
Exit Velocity	**4,200 m/s**
Throughput Mass	**22.5 mg/s**

Table 1. Propulsion System Power Data

- Now Available -

Word search capable CD ROM versions of *The AMSAT Journal* are available from AMSAT-NA for the (Phase 3D development) years:

1998-2000 (Volumes 21-23)

1995-1997 (Volumes 18-20)

Prices for each set is $20.00 for members and $60.00 for non-members. **A special price for the combined set (1995-2000) is $30.00 for members and $90.00 for non-members.** Please include $5.00 with each order for shipping and handling. For complete details contact Martha at 301-589-6062. ***Order yours today!***

AMSAT-CE Builds CESAR-1

Jörg-Peter Zäch, DH3NBC

Translation from the AMSAT-DL Journal *by John J. Bubbers, W1GYD*

In July 2001 it is anticipated that CESAR-1, a microsat built by AMSAT-CE, will be circling the Earth in a polar orbital path. The payload will contain five experiments: Digipeater, BBS, Digital Speech Transmissions, and position location using GPS.

CESAR-1 (*CE Chile, Satellite de, Afficianados a las Radiocommunicaciones*) is the first project of AMSAT-CE and is a satellite of the microsat series having dimensions of 23 x 23 x 23 cm. The team is hoping for a launch on a Chinese carrier rocket in July, 2001; a polar, sun synchronous orbit at 800 km altitude with an inclination of 98.62 degrees is planned with an orbital period of 101 minutes. The planned life expectancy is 10 years.

- Name: CESAR-1
- Planned Launch Date: July 2001
- Orbit: Polar, sun synchronous LEO
- Inclination: 98.62°
- Orbital Period: 101 Minutes
- Satellite Type: Microsat
- Weight: 12.0 kg
- Dimensions: 230 x 230 x 230 mm

The CESAR-1 Microsat

CESAR-1, like all microsats, consists of five mechanical modules also called trays. Similar to AO-27; they are made on an aluminum frame having dimensions of 20 x 20 x 4 cm and each contains a self-contained function. The complete module package, together with the 6 surrounding solar cells, is 23 x 23 x 23 cm, and weighs 12 kg; 5 antennas are located on the outer surface. The receiving antennas are on one side; for 2 meters and 23 cm there is a quarter wave length antenna for each, as well a patch antenna for the GPS receiver. The transmitting antennas are situated on the opposite side; one antenna is composed of two radiators connected together for circular polarization on 70 cm and a patch antenna for the 13 cm downlink.

CESAR-1 rotates around its Z-axis, which points to the earth; in the four vertical corners there are permanent magnets located for attitude stabilization. One side of the 70 cm antennas is painted white, which sets the satellite in circular motion because of solar radiation. The rotational motion can be controlled in the Z-axis by seven rods located in the 3rd module.

The following units are housed in CESAR-1 on the individual trays:

Module 1

The lowest module houses two transmitters, each with an output power of 4 Watts at 436.600 MHz and 436.650 MHz, one transmitter with an output power of 0.5 Watts on 2420.00 MHz, as well as the electronics for the switching. The frequencies of the transmitters are quartz controlled.

Module 2

In the module mounted just above are the on-board computer with CPU, memory, and various other cards.

Module 3

The power supply is located in the 3rd module. Eight NiCd storage batteries with a capacity of 7.2 A supply the satellite during eclipse. The electronics for the battery management are also located here. The voltages for the supply of individual systems are generated here as well.

Module 4

The GPS receiver and the electronics for the digital speech transmitter and speech compression are located here.

Module 5

In the uppermost frame there are 3 receivers for 145.860 MHz and 145.940 MHz as well as 2 receivers integrated for 1267.050 MHz and 1267.250 MHz. The receiver frequencies are similarly fixed. In total, five experiments/operation modes are planned: Digipeater, BBS, Digital Transponder, GPS, and Digital Voice.

Digipeater

The digipeater operation mode CESAR-1 is configured as Mode VHF/UHF (V/U) Digipeater for 9k6 FSK (G3RUH) and makes Realtime Packet possible for a 6500 km range. There is actually one receiver and transmitter in operation at any given time. A modem for GMSK is also available.

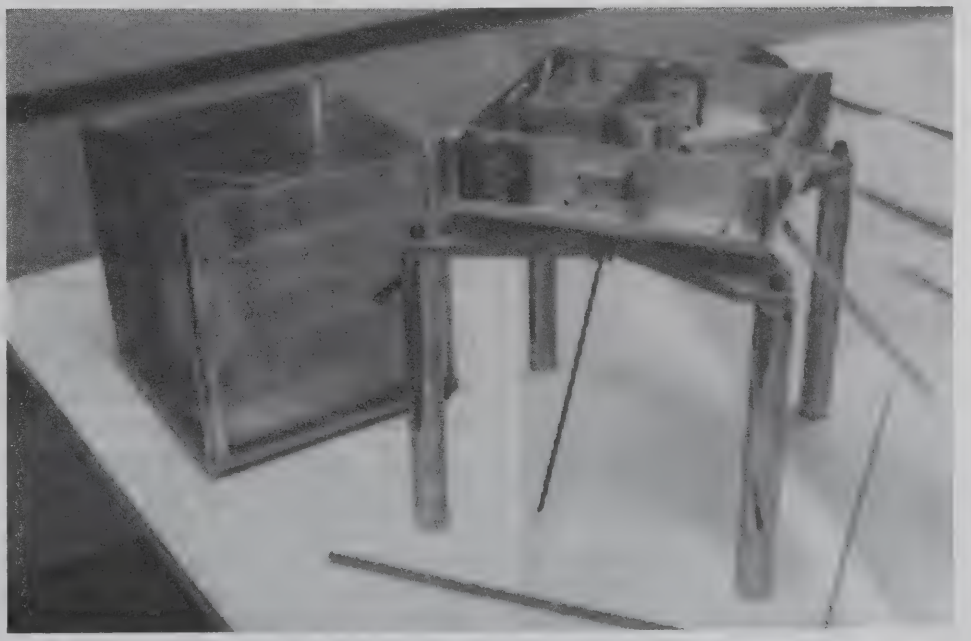

Figure 1: Mounting the first tray in CESAR with the transmitters

Figure 2. 70 cm transmitter

Figure 4. GMSK modem

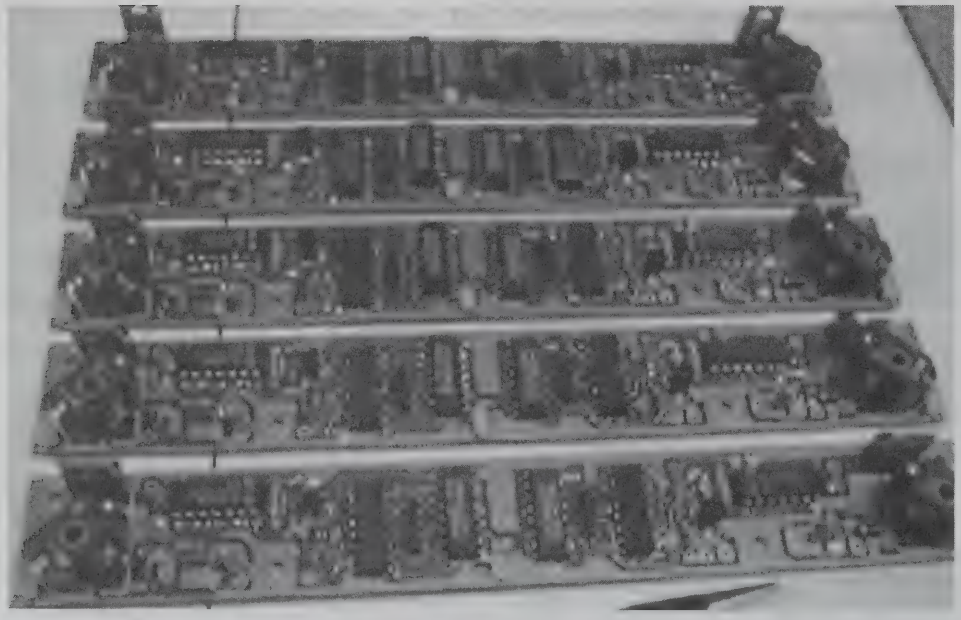

Figure 5. The AART Boards (Addressable Asynchronous Receiver Transmitter), the interfaces for the data transfer between the modules and the CPU.

BBS

The BBS operates at 9k6 FSK in mode V/U like PacSats UO-22 and KO-25, in which 2 receivers and 2 transmitters are in operation. Likewise, a modem for GMSK is available.

Digital Transponder

In this experiment, if one wants to connect two FM repeaters which are in CESAR-1's window, one would operate normally into the FM- repeater with a normal hand-held (1), a digital translation would result in the transmission to CESAR-1 via CESAR-1's L/S transponder with another reachable FM repeater (2).

The ham operator in the second station operates in analog as usual over the FM repeater (2), and here a digital translation for transmission onto the satellite takes place.

Everything is transparent to the user; he experiences nothing of the satellite connection, but by these means can cover large distances with low local power. Presently, of the 40 FM repeaters in Chile, 11 will be expanded for digital communications with CESAR-1.

The expansion of FM repeaters in other countries would be possible by this method. Naturally, both ground stations must be visible to the satellite simultaneously, since the transmission system operates in real time.

GPS

The actual position of CESAR-1 in longitude, latitude and altitude can be computed with the GPS receiver and the CPU. The position is then transmitted to earth by the Digital Voice Experiment.

Digital Voice

The ground station transmits several communications to the satellite on 2 meters in analog format, where they are digitized and compressed and stored in the RAM. They can then be channeled to the 70 cm band by the CPU for transmission (Digitalker). Likewise, the GPS acquired latitude, longitude and altitude can be presented as speech. This way newcomers can easily follow the orbit of the satellite.

Frequencies

Downlink:

- 436.600 MHz 4 W 9k6 FSK, GMSK
- 437.650 MHz 4 W 9k6 FSK, GMSK

- 2420.00 MHz 0.5 W dig. Voice

Uplink:

- 145.860 MHz 9k6 FSK, GMSK
- 145.940 MHz 9k6 FSK, GMSK
- 1267.050 MHz digital voice
- 1267.250 MHz digital voice

My thanks to Ignacio, CE2MH for the information.

Internet References

http://www.entelchile.net/amsatce/cesar1.htm

Homepage AMSAT-CE (Spanish) ■

Future Amateur Radio Satellites

Jörg Peter Zäch, DH3NBC

(As of 02 November 2000, all information without warranty)

Satellite	Estimated Launch Date	Payload. Sponsor, & Comments
CESAR-1	July 2001	Digipeater, BBS, Digitalker, Dig. L/S Transponder, GPS, AMSAT-CE
HAND	?????	Digitalker UHF Downlink (similar to Dove), AMSAT-UK University of Bristol, Launch from Space Shuttle
Kollibri	2001	Telemetry Digital Voice Recorder, Launch from Progress
PehuenSat-1	2001?	VHF Parrot-Repeater, VHF Voice Telemetry, AMSAT-LU
PehuenSat-2	????	Scientific Voice and Data in V, U, L, S Band Camera for Antarctica Pictures, AMSAT-LU
SAPPHIRE	2001	CCD Camera, Speech Synthesizer, Stanford University, Launch Ready
SATEDU	End of 2001	U/V, U/S Transponder for FM, CW, SSB Digital Store and Forward, AMSAT-F
VOXSAT-1	2000?	VHF FM Speech Bulletins/ Parrot-Repeater, CW Telemetry, AMSAT-LU

Satellite Orbital Elements

by Ray Hoad, WA5QGD

Satellite	AO-10	UO-14	FO-20	RS-12/13	RS-15	FO-29	AO-27
Catalog Number	14129	20437	20480	21089	23439	24278	22825
Epoch Time	1128.37621573	1130.20543492	1130.74959238	1130.06374643	1129.62210642	1130.70208945	1130.32657473
Element Set	790	684	311	333	540	413	976
Inclination	26.5933	98.3613	99.0622	82.9185	64.8201	98.5483	98.3542
RA of Node	273.5385	191.5891	206.1644	303.2794	12.5511	1.0047	180.3931
Eccentricity	0.6000605	0.0010374	0.054102	0.0028113	0.0165837	0.0351989	0.0009058
Arg of Perigee	148.0131	332.8907	33.9674	297.3352	233.5467	98.9998	24.6584
Mean Anomaly	269.3616	27.1733	329.4859	62.4935	125.0074	265.1144	335.503
Mean Motion	2.05866335	14.30708867	12.83292077	13.74267762	11.2754088	13.52771455	14.28413118
Decay Rate	-0.000003	0.00000268	-0.00000076	0.0000014	-0.0000004	0.00000081	0.00000295
Epoch Rev	13462	58962	52729	51457	26231	23357	39717
Satellite	AO-40	UO-11	AO-16	DO-17	WO-18	LO-19	UO-22
Catalog Number	26609	14781	20439	20440	20441	20442	21575
Epoch Time	1130.37527503	1130.87302902	1129.74458838	1130.19606109	1130.32439663	1129.74394174	1130.19954039
Element Set	72	497	484	476	500	483	204
Inclination	5.1772	98.031	98.4051	98.4177	98.4156	98.4265	98.1276
RA of Node	195.603	95.3672	199.1388	202.0985	201.7874	203.1981	146.4996
Eccentricity	0.8142594	0.001141	0.0010833	0.0010908	0.0011368	0.0012068	0.0006612
Arg of Perigee	265.1498	127.7645	339.1233	336.3655	336.1911	337.1075	300.3231
Mean Anomaly	9.4313	232.4597	20.9506	23.702	23.8746	22.9566	59.7302
Mean Motion	1.27001451	14.73947963	14.30832146	14.31047181	14.30925303	14.3107135	14.38147411
Decay Rate	0	0.00002111	0.00000347	0.00000385	0.00000316	0.00000352	0.00000561
Epoch Rev	242	92054	58958	58970	58971	58967	51491
Satellite	KO-23	KO-25	IO-26	TO-31	GO-32	SO-33	PO-34
Catalog Number	22077	22828	22826	25396	25397	25509	25520
Epoch Time	1130.86483662	1130.17919839	1130.65715078	1129.96399157	1129.90190599	1129.61908084	1129.60579527
Element Set	0	939	963	523	785	302	360
Inclination	66.0874	98.3567	98.3589	98.6861	98.6828	31.44	28.4615
RA of Node	44.1942	181.2507	181.4934	207.6261	207.1285	218.6227	214.5521
Eccentricity	0.0014705	0.0010815	0.0009726	0.000273	0.0000721	0.03622	0.0007091
Arg of Perigee	244.6759	2.8504	21.8079	184.0967	177.366	34.7872	170.8537
Mean Anomaly	115.2736	357.2735	338.3511	176.0192	182.7522	327.5883	189.2182
Mean Motion	12.86365481	14.29005682	14.28583685	14.22986771	14.22588177	14.25685843	15.08250492
Decay Rate	-0.00000037	0.00000261	0.0000033	-0.00000044	0.00000151	0.00000526	0.00003617
Epoch Rev	41086	36536	39725	14712	14711	13243	13917
Satellite	SO-35	UO-36	AO-37	OO-38	WO-39	ISS	TIUNGSAT
Catalog Number	25636	25693	26065	26063	26061	25544	26548
Epoch Time	1129.94423528	1130.77474298	1130.84698756	1130.33512523	1130.85861783	1130.78961909	1129.74830821
Element Set	535	804	219	222	251	959	117
Inclination	96.4719	64.5621	100.1919	100.192	100.1905	51.572	64.5583
RA of Node	260.9228	191.7772	57.6193	56.9871	58.0567	277.2562	222.3688
Eccentricity	0.0150087	0.0047713	0.0037485	0.0037135	0.0035843	0.0017383	0.0029113
Arg of Perigee	228.475	252.9924	312.9887	312.8552	310.34	33.4649	336.2077
Mean Anomaly	130.3501	106.5944	46.8151	46.9506	49.4647	121.5471	23.7696
Mean Motion	14.41856863	14.7380241	14.34611259	14.34658713	14.35615388	15.59416082	14.76785111
Decay Rate	0.0000069	0.00000667	0.00000529	0.00000435	0.00001227	0.00045427	0.00002007
Epoch Rev	11616	11057	6733	6726	6737	14123	3325

AMSAT-India Plans

Nagesh Upadhyaya, VU2NUD (*vu2nud@amsat.org*)

The idea of constructing and launching an Indian Amateur Radio satellite has been in our minds for quite a number of years now. For the past 18 years, I have worked for the Indian Space Research Organization (ISRO) as a payload electronics specialist. ISRO is involved in constructing and launching the following three classes of satellites/launch vehicles:

- Polar Satellite Launch Vehicle (PSLV) that launches Indian Remote Sensing class (900kg) into Polar Sun-synchronous orbits launched from our launch complex in Sriharikota.

- INSAT class of commercial satellites in geosynchronous orbits being launched from Kourou, French Guiana. Presently, there is an augmentation of facilities in Sriharikota for geosynchronous launch vehicles.

- Rohini series of about 50kg class satellites, which were put into low-earth circular orbits using SLV/ASLV launchers. The Rohini series is presently discontinued.

AMSAT-India will have to make a meaningful Amateur Radio experiment to suit one of the above classes of vehicles, however we have had good encouragement from ISRO. The best assurance we received was from our Chairman, Dr. K. Kasturirangan. While inaugurating a Hamfest in Bangalore, he said that AMSAT-India could possibly put a payload on an ISRO's missions in the near future. However, it is generally felt that AMSAT-India would make the satellite ready well in advance of a launch opportunity. Given this direction, I am trying to get the attention of International Amateur Radio community. I have been communicating with various persons in AMSAT and years ago I had the opportunity to go to University of Surrey and attend the Data Space Conference. I have also received good encouragement from Ray Soifer, W2RS, Executive Vice-President, AMSAT-NA.

In a recent AMSAT-India meeting at Hyderabad, we had a serious brainstorming session regarding the construction of an Indian Amateur satellite. Rama Mohan Rao, VU2RM; R. Ramesh, VU2RMS; and myself met to describe amateur satellite communication in general and constructing a satellite payload in particular. [It may not be out of place, if I mention here that Rao was the second Indian to make Amateur Radio contacts via satellite (the first being V. Subramanian, VU2UV again from Bangalore). They used a variety of home-brew and war-surplus equipment to make history. Ramesh's Little Lillys School was the first, and probably the only school, from India that made a SAREX contact.] After our meeting, we sent a communication to all those concerned to get feedback on the possible configuration of an Indian amateur satellite. Based on these inputs we will work out a final configuration design.

Discussions over breakfast at the AMSAT-India Meeting. Mr. S.N. Prasad, ISRO official is at the extereme right. Second from the left is Mr. Dev Prablui, VU2DEV of the VUSAT transponder team.

Most acceptable bands seem to be: 10m, 2m and 70cm. Various combinations of uplink and downlink have been suggested. Also, there could be the possibility of a satellite beacon on one of these frequencies. There has been a fairly good response from all parts of the country with suggestions ranging from a Parrot repeater via all combinations of HF-VHF-UHF uplinks and downlinks. One interesting issue that arose from suggestions is the problems that cable and cordless operators cause on 2m and how we should take care of it for satellite operation.

Presently we are planning for a linear transponder and a beacon. Sri Bhat, VU2SBJ and the group from Manipal Institute of Technology have started design of a satellite beacon for 144MHz. Sanath Kumar, VU2YI from Nehru Science Centre in New-Delhi has come forward with some suggestions to improve this. Most likely the satellite beacon will be a joint effort between these two groups.

We are planning for a payload only satellite but it may also be able to piggyback ride on any satellite (presently not defined). In this plan, we envision there is no scope for a microprocessor or any complicated digital circuitry. We'll have to make a simple transponder and beacon. In addition, this has to be demonstrated on the ground before qualification as a satellite payload. The present model will be called a demo-model that will be followed by a engineering/proto-flight model and ultimately a flight model.

To add value to our satellite, one can still think of adding useful circuitry to the beacon (like the voice chip). Please note that power, weight, and volume are at a premium on our satellites. The total (transponder +beacon) power should be in the range of 5-8 watts and the weight cannot exceed 10kg. The systems we make will have their own regulators and will derive power from the satellite raw bus of 28-42 Volts.

To generate more interest in AMSAT-India we have started a satellite chat network on the 7.070MHz (this is a very popular band for Indian hams) every Sunday during 0730-0800hrs IST.

Another pioneering effort is being done by stalwart Bindu Rao, VU2IR who has produced *Sat-Samachar* (Samachar news in Hindi) giving details of satellite activities in

India. This is available in electronic format via request to *vu2ir@vsnl.net*. Again, Kumar, VU2YI, is instrumental in starting a forum on www.egroups.com/group/vusat for information dissemination.

The first AMSAT-India working group meeting was called on 21JAN01. During this meeting we discussed various options for an Indian satellite to determine an optimal configuration (see minutes). We also hope to determine whether any group can take up the transponder development. I have called the meeting of about 10-15 hams who are the best amateur satellite brains in this county and we hope to see a working transponder and beacon within next two years. Otherwise again there can be a long pause.

Now we need to develop the hardware. For this we need the support of hams, institutions, clubs, the government and ISRO. We need international support too. We are open to any international group collaborating with us for the development of a ham payload for a possible launch from Indian soil. However lots of hurdles may have to successfully jumped. An international collaboration like this will have a greater impact for a successful project. Also note that nothing is guaranteed. It is for us to push our dream project hard, have the hardware on hand and then approach for an opportunity and possibly wait for it. Such being the case, we envisage a payload that is an independent platform.

To quote from Jules Verne: *Anything that one can imagine, someone can make it real.*

Minutes of the AMSAT-India Second Meeting Held on 18 March 2001

Participants: V. Subramanian, VU2UV; Bindu Rao, VU2IR; R. Ramesh, VU2RMS; Dev Prabho, VU2DEV; Bob, VU2MKP; Nagesh Upadhyaya, VU2NUD; R. Guruaja, VU2GUR; and D. John, Deputy Director, SATCOM-ISRO.

The meeting was hosted by the Little Lilly's School with the courtesy of Ramesh, VU2RMS. Nagesh, VU2NUD welcomed the gathering (and Mr. John in particular) touching upon the background and giving details about the previous meeting, configuration, teams were described.

Progress with respect to transponder design and beacon design was discussed. Beacon design sent by Sri, VU2SBJ (who could not attend the meeting, but sent details) was reviewed in great detail. A proposal from AMSAT-Italia President, Paolo Pitacco, IW3QBN came up for consideration. More details in the form of a detailed proposal are awaited. Further it was mentioned that frequency coordination work is in progress and exact frequency will have to be decided after receiving communication from the IARU Satellite Frequency Coordinator.

The author, Nasgesh Upadhyaya, VU2NUD describing VUSAT to AMSAT-India meeting participants

It was mentioned that, Dr. P. S. Goel, Director ISRO Satellite Centre and Mr. J. P. Gupta, Project Director for Small Satellite had discussions with Nagesh and showed keen interest in the development of the VUSAT payload.

Dev, VU2DEV presented the design of the transponder VHF downlink portion. He showed the link calculations and power budget taken for his design. Messrs. John, Subi, Bindu and Bob reviewed the design and suggested suitable modifications with respect to range and path loss. Dev was requested to send the details to the core team in hardcopy/electronic form along with circuit/block details. He indicated that there is good progress with respect to downlink hardware development but the UHF uplink portion is yet to be taken up. He requested downlink frequencies of 145.805 or 145.815 or 145.835 MHz. He indicated second IF of 11.5 MHz

A section of the gathering of participants to the AMSAT-India meeting. Second from the left is V. Subramanian, VU2UV, the first Indian ham to make a contact through amateur satellites.

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instead of 10.7MHz since it is readily available with him. Members congratulated him on his good work and progress. Dev also requested for TNC connectors for RF and circular connectors for power be made available to him.

The final configuration of VUSAT as it is approved today is the following:

• There will be main and redundant transponders - either Indian/Italian or Indian/Indian. (We need a detailed proposal regarding the Italian transponder for approval by ISRO).

• There will be main and redundant bea cons

- sbj beacon - with messaging on nbfm

- sf beacon - with modulating VUSAT parameters, like raw bus voltage, tempr., current, main/rdn status etc.,

(Second beacon is subject to final word from VU2SF, who did not attend the meeting. We are waiting for confirmation from VU2SF regarding his plans).

Beacon and transponder work will go on in parallel until the time of final configuration and integration. Any package coming first will be tested and qualified. The final selection will be based on conditions at the time of the flight model.

It was concluded that there will be visit by a few members of the team to facilities at ISRO satellite center (ISAC), meeting with Director, ISAC, meeting with Scientific secretary, ISRO and finally a meeting with Chairman, ISRO. Members thanked Ramesh, VU2RMS for excellent hospitality and Mr. John for sparing his valuable time to review the configuration and design.

GSLV Launched Successfully

(18 April 2001 via ISRO) The first developmental test flight of India's Geosynchronous Satellite Launch Vehicle, GSLV, was successfully carried out this evening (April 18, 2001) from SHAR Centre, Sriharikota, about 100 km north of Chennai, India marking a major milestone in the Indian space program. With this launch, India has demonstrated its capability to launch communication satellites, into geostationary transfer orbit with a perigee (nearest to the earth) of 180 km and an apogee (farthest to the earth) of 36,000 km. This paves the way for end-to-end capability of application - spacecraft launching in the communication area also.

The 401 ton, 49 m tall GSLV, carrying an experimental, 1540 kg, satellite, GSAT-1, lifted off from Sriharikota at 0343 IST. Seventeen minutes after lift off, GSAT-1 was successfully placed in an orbit of 181 km perigee and an apogee 32, 051 km with an orbit inclination of 19.2 degree with respect to the equator. The injection of the satellite into orbit occurred about 5000 km from the launch center.

It may be recalled that the first launch attempt of GSLV was aborted one second before the lift-off on 28 March 2001 by the Automatic Launch Processing System (ALS) after it detected that one of the strap-on boosters did not develop the required thrust. After detailed analysis, the exact reason was identified, recovery operations were completed in 18 days and the vehicle was made ready for relaunch.

The countdown commenced 57 h 49 m prior to lift-off, i.e., 5:56 AM (local) on 16 April 2001. The countdown activities like filling of fuel for the second stage and the four strap-on motors, arming of pyros, movement of Mobile Service Tower, filling of cryostage and electrical checks were done smoothly. After station checks on all mission elements, the authorization for the mission was given at 16 minutes before lift-off. The Automatic Launch Processing System took over at 12 minutes before lift-off.

As the countdown for the launch proceeded, at 4.6 seconds before the count zero, the four liquid propulsion strap on stages, each car-

Launch of GSLV, 16 April 2001. (ISRO photo)

rying 40 ton of propellant, were ignited. After confirming the normal performance of the liquid propulsion strap-on motors, the whole system was released one second before lift-off and at count zero, the mammoth 125 ton solid propellant first stage motor was ignited and GSLV blazed into the evening sky. The first stage burned for 100 seconds while the liquid propulsion strap on stages continued thrusting up to 162 seconds from lift-off taking the vehicle to an altitude of 75 km. At the end of the first stage burn out the GSLV had reached a velocity of 2.63 km per second.

The second stage, which carried 37.5 ton of liquid propellant, ignited 1.6 seconds before the burn out of the first stage strap-on motors. This stage burned for 147 seconds taking the vehicle to an altitude of 126 km and increasing its velocity to 5.18 km per second. During the second stage operation, when the vehicle was at an altitude of 116 km and thus cleared the dense atmosphere, the heat shield that protects the spacecraft from the aerodynamic heating, was discarded.

After the separation of the second stage at 314 seconds from lift off, the cryogenic stage was ignited. The cryogenic stage, which carried 12.5 ton of liquid hydrogen and liquid oxygen burned for 693 seconds taking the satellite and vehicle equipment bay to an altitude of 195 km and increasing the velocity to 10.17 km per second as required for placing the satellite in the geostationary transfer orbit. The stage which was procured from Russia and interfaced with ISRO developed electronics, was separated from the spacecraft at about 1036 seconds from lift off at an altitude of 202 km about 5000 km from the launch pad at Sriharikota. After separation, the cryogenic stage was reoriented to avoid any collision with the satellite and made passive.

All through the flight, the vehicle was guided by the inertial navigation and guidance systems. The performance data of the GSLV was telemetered to the ground stations in Sriharikota, Port Blair and stations at Brunie and Biak in Indonesia that were networked with SHAR Centre.

The first signals acquired from the GSAT-1 indicate normal performance of the satellite. Further operations like orbital maneuvers to take the satellite from the geosynchronous transfer orbit to its final geostationary orbit at 36,000 km using the on board apogee motor and deployment of its appendages like solar array, solar sail and the antenna, GSAT-1 will be carried out in the coming days. GSAT-1 carrying three C-band transponders and one S-band transponder, will be used for conducting communication experiments like digital audio broadcast, Internet services and compressed digital TV transmission. Several new spacecraft elements like improved reaction control thrusters, fast recovery star sensors and heat pipe radiator panels are also being tested on this satellite.

The successful accomplishment of GSLV-D1/GSAT-1 Mission is the culmination of a decade of efforts of ISRO Centers' in design and development and supported by several educational and academic as well as R&D institutions in the country. Many of the GSLV hardware items including motor cases, interstages, heat shield, engine components, electronic modules are manufactured by the Indian industry. About 150 industries in both the public and private sectors are involved.

GSLV is the most technologically challenging mission undertaken so far under the Indian space program. It is the culmination of efforts of a large number of scientists, engineers and technicians, over the last ten years. The mission heralds a significant milestone towards the establishment of indigenous capability for launching communication satellites like INSAT. Having already established indigenous capability for launching IRS class of remote sensing satellites through PSLV, the launch of GSLV makes the Indian space program even more self-reliant while tuning the program towards national development. ■

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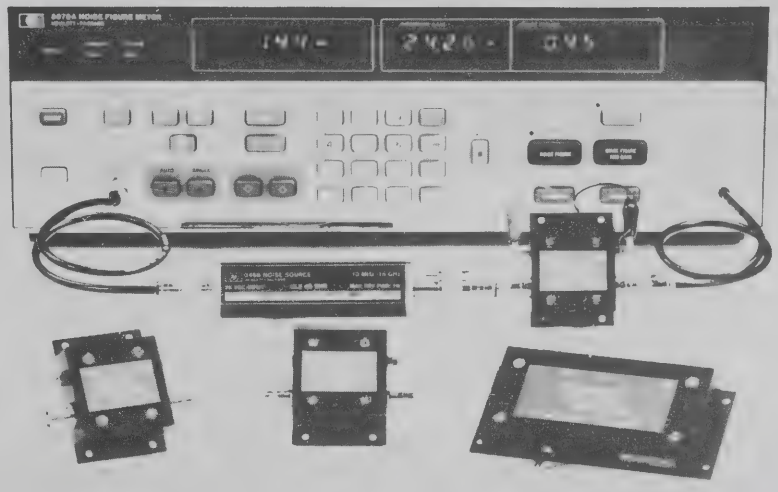

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P144VDG	144-148	<0.5	24	+12	GaAsFET	$79.95
P220VD	220-225	<1.8	15	0	DGFET	$29.95
P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
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SP144VDA	144-148	<1.1	15	0	DGFET	$67.95
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SP220VDG	220-225	<0.55	20	+12	GaAsFET	$109.95
SP432VD	420-450	<1.9	15	−20	Bipolar	$62.95
SP432VDA	420-450	<1.2	17	−20	Bipolar	$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	$109.95

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AMSAT Journal Telemetry

(continued from page 2)

AMSAT-DC 2001 Participants at the NASA Goddard Space Flight Center Visitor Center. (Photo by Charlie Heisler, K3VDB)

AMSAT-DL Symposium News

The afternoon of the AMSAT-DL Symposium began with a review of the launch-campaign by Peter Guelzow, DB2OS, and a video-presentation of the launch itself.

Karl Meinzer, DJ4ZC, subsequently explained, what had since happened with AO-40. He expounded, that the incident that occurred on 13 December 2000 has been technically clarified and the human component, which led to the incident, has been understood. The goal is now, to rule out like problems for the future and concentrate on the commissioning of AO-40. The *catastrophe* was triggered by a vent opening of a valve of the 400-N motor that was left plugged up. As a consequence, remnants of fuel were left in the cooling shell of the motor that subsequently forcibly escaped through a leak.

Sergei Kirkalev, U5MIR of the First Expeditionary Crew making an ARISS contact.

Karl Meinzer then explained the current situation of AO-40. After successful magnetorquing, the satellite should be maneuvered to an attitude that permits testing of the arcjet-engine. (*Editor's note: see page 14 of this issue for a description of the AO-40 arcjet.*) The results of this test determine further planning towards orbit changes involving the arcjet and the commissioning of AO-40. Presently AO-40 is in a 440-day long cycle with regard to the solar angle with alternating phases. 110 days provide suitable alignment of the antennas and the solar cells for firing of the arcjet. Provided the ATOS-tests proceed satisfactorily, the first transponder operation could begin earlier than originally planned, possibly still in the first half of 2001.

Vicksburg, Mississippi ARISS Contact Deemed A Success

After a couple of false starts, nine Vicksburg High School students got their chance to talk with an astronaut aboard the International Space Station on Wednesday, 11 April 2001. The contact occurred at 0715 CDT and was near perfect. Two previous opportunities for the contact were scrubbed because of ISS crew work load.

Although the Vicksburg Amateur Radio Club had installed antennas and equipment at the school, the contact ended up being telebridged through the Sacred Heart Academy Amateur Radio station in Honolulu, Hawaii. This was necessary in order to accommodate the work load of the ISS Crew and schedule the contact at a reasonable time of the day for the students. Nancy Rocheleau, WH6PN, and Dick Flagg, AH6NM, were the operators at Sacred Heart.

The nine students asked 18 questions of Astronaut Susan Helms during the nearly 10 minute pass. Questions ranged from the salary of an astronaut to the sensation of riding the shuttle to orbit. One student, who is 6' 3" tall, asked what were the height limitations for astronauts.

Eddie Pettis, N5JGK, president of the Vicksburg Amateur Radio Club, noted that the contact was a very successful community-wide effort. The City of Vicksburg provided commemorative t-shirts for the participants and also provided a Fire Department Snorkel Truck for erection and knockdown of the antenna system. Vicksburg Mayor Robert Walker attended the contact and is-

sued a proclamation designating Wednesday, 11 April, as Space Awareness Day in Vicksburg. Vicksburg Chemical Company, the sole provider of one of the fuels for the Space Shuttle, will present plaques to the students.

There was excellent media coverage of the event. Several stories were ran in the *Vicksburg Post*, two television stations from Jackson (WAPT and WLBT) provided extensive coverage, two of Vicksburg's radio stations (WQBC and WBBV) broadcast the contact live, as did the City of Vicksburg's cable TV channel. Former NBC Space Reporter Roy Neal, K6DUE, and ARISS Coordinator Will Marchant, KC6ROL, moderated national coverage of the contact through the facilities of World Com. (Information provided by Bill Ford, W5WAF)

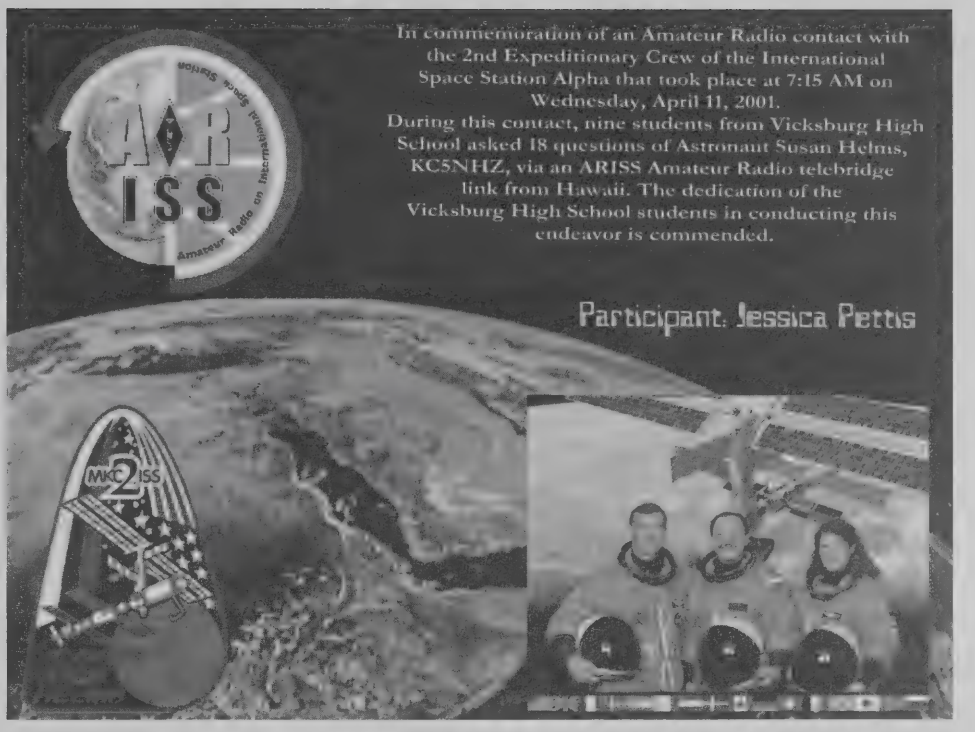
Results of the Recent AMSAT-DC Meeting
By Maggie Leber, K3XS

The Maryland-DC area AMSAT Meeting and Space Seminar was held Sunday, 01 April 2001 in the Visitor Center auditorium of the NASA Goddard Space Flight Center in Greenbelt, Maryland. Keynote speaker Rick Hambly, W2GPS, gave a detailed presentation on the recovery of AO-40 telemetry and of the efforts the AO-40 Telemetry Improvement Team. There's certainly some fascinating work being done in this area, one of my personal interests.

Bob Rose, AA3RR, cofounder of KI3DS, told us about his efforts building an organization to make Amateur Radio more accessible to young folks. It's a truism that we should be concentrating on bringing succeeding generations into ham radio, and space operations should be one of our a major drawing cards. Bob is actually *doing* something about it.

2001 Dayton Hamvention award winner Frank Bauer, KA3HDO, AMSAT VP for Human Spaceflight Programs, briefed us on future plans for ARISS equipment and enhancements (including packet, SSTV and ATV), while Will Marchant, KC6ROL, gave us an update on current and near-future ARISS operations. Ken Nichols, KD3VK, followed regarding the AMSAT-DC direct involvement in the development project. Ken invited participation in the Saturday morning AMSAT working group in *playing* with ARISS space flight hardware!

On the Show 'n' Tell display tables were examples of the new ARISS UHF/VHF and HF antennas, as well as the ARISS packet controller (KA3HDO/N8FGV). W2YE brought in his club's SAREX QSL displays and challenged other clubs to volunteer for a similar ARISS QSL-processing task. A number of other exhibits showed work members are doing with microwave antennas (WB4APR), test equipment and transmitting and receiving systems (N4MW). The Microsat mechanical test model visited us too (W3IWI).


ARISS
Amateur Radio on International Space Station
In commemoration of an Amateur Radio contact with the 2nd Expeditionary Crew of the International Space Station Alpha that took place at 7:15 AM on Wednesday, April 11, 2001.
During this contact, nine students from Vicksburg High School asked 18 questions of Astronaut Susan Helms, KC5NHZ, via an ARISS Amateur Radio telebridge link from Hawaii. The dedication of the Vicksburg High School students in conducting this endeavor is commended.
Participant: Jessica Pettis
MKC 2 ISS

Certificate of Appreciation for the Vicksburg ARISS Contact.

On the official end of things Robin Haighton, VE3FRH, shared some views from the AMSAT-NA captain's chair, and Barry Baines, WD4ASW, explained his Field Operations organization and the valuable and very flexible roles of AMSAT Area Coordinators.

Dick Daniels, W4PUJ, presented *What Happened To AO-40*, starting with a slide show of photos from the AO-40 launch campaign and then donned his AO-40 Propulsion Systems Manager hat for a concise but detailed and authoritative review of what is known,

Malcolm Preston, NP2L recently returned from an April 2001 visit to Japan where he attended a wonderful reception hosted by a group of JAMSAT enthusiasts. The above photograph was taken at a dinner they hosted at Nagoya University. From left to right are seated are Shosi, JR2DUD; Shiro JA2ORW; Mori, JA2AYT (KE8YH); standing are Masaaki, JE3MXQ (AA8WK); and NP2L.

Tony Hutchinson, VK5ZAI and STS-102 Mission Specialist, Andy Thomas, VK5MIR at the NASA Johnson Space Center, Houston, Texas upon completion of the STS-102 mission. Tony developed a unique friendship with Andy during his stint on *Mir* (see the March/April 1999 issue of *The AMSAT Journal*). Tony and his XYL Jill were invited to view the launch as special guests of VK5MIR.

Tony and Jill also had the opportunity to meet William "Shep" Shepherd, KD5GSL Commander of the First Expeditionary Crew to the ISS. At the time of this photograph, it had been less than 48-hours since Commander Shepherd's return to Earth.

Big Game Hunting with VK5ZAI in Wilds of Mississippi? While STS-102 was in orbit on their 10-day mission, Tony and Jill took time to visit many hams in the Southeastern U.S including Russ Tillman, K5NRK's QTH in Vicksburg, Mississippi. During their visit, Tony and Jill observed a bobcat strolling through K5NRK's backyard. Since they were in their tourist mode, a camera was readily available to capture the event. K5NRK thankfully reports he hasn't seen the bobcat since but reports that the photograph should make a great QSL card!

suspected, and not known about events aboard AO-40.

AMSAT President Emeritus Tom Clark, W3IWI, was entertaining, witty and wise holding forth on the subject of what it *really* takes to get a satellite on orbit (and how very little of it really has much to do with Amateur Radio) as well as the scaling of cost, scheduling and reliability as the complexity of a satellite design rises.

Bob Bruninga, WB4APR, the resident Mad Scientist of Annapolis, brought and demonstrated his $500 briefcase-sized automated digital satellite station, and spoke about the student PCsat project of the Naval Academy, as well as some of his other projects such as possible new PSK-based birds.

This was my first time attending this annual event, and I'm sure to be a regular in the future. Perhaps the most valuable part of the event was the time spent in personal introductions from everyone attending, followed by a group photo session and half an hour's socializing and schmoozing time; a fertile networking opportunity, indeed.

AMSAT Area Coordinator Pat Kilroy, N8PK, did a highly polished and professional job of organizing and orchestrating the whole shebang, and we're all in his debt on that score. Several in attendance helped with a number of housekeeping items such as talk-in (KB3EFS); room setup, knockdown and cleanup; and other necessary chores.

This is an annual event, so if you're within striking range of the DC area next year, make room for it in your calendar!

AO-40 Opening Day! This photo of Mike Seguin, N1JEZ (the bearded one) and Tom, N1GZZ in the N1JEZ shack after just completing a contact via AO-40 with Dick Jansson, WD4FAB. Mike said it was really neat talking to Dick. His comment was "how happy he was to see about 11 years worth of work finally bear fruit!" Amen!

AO-40 News

April 2001 continues with recovery efforts concerning AO-40. The satellite is healthy and recent reports indicate that very good telemetry along with excellent downlink signals have been received recently. The most exciting news is that successful transponder and matrix operation has been performed. The following is from AMSAT-DL:

Dear All,

On orbit 226, the U, L and U+L receiver passbands were connected to the (S-2) S-band downlink and were briefly checked out by command stations G3RUH and W4SM - using PSK, CW and SSB signals for the uplink. The tests worked extremely well and confirm that the matrix switch is working in these combinations. This prepares the way, with confidence, for transponder operation very soon, when the attitude approaches ALON-0/ALAT-0, via on-going magnetorquing.

Stay tuned for further announcements regarding general transponder operations!

73,

For the AO-40 Command Team:

Peter Guelzow, DB2OS

AMSAT-NA President Robin Haighton, VE3FRH, recently completed a conversation with the ARRL concerning AO-40; the complete story is included here:

AMSAT-NA President Robin Haighton, VE3FRH, this week raised the possibility that AO-40 could inaugurate transponder operation this summer, if tests and orbital maneuvers between now and then go as planned. "We are learning how to fly this thing," Haighton said. "But I still think we're going to end up with a darned good satellite."

The most likely initial transponder configurations would be Mode US, or 435 MHz up and 2.4 GHz down — and Mode LS — 1.2 GHz up and 2.4 GHz down. "It looks like a good bet," Haighton said of the probability that the two modes would prove useful from the damaged satellite. He predicted that Mode US operation from AO-40 would surpass what had been available a few years ago from the now-defunct AO-13. "We're getting something like 27 dB more signal."

As the AO-40 recovery effort continues, Haighton said, ground controllers plan to boost the satellite's orbit in the very near future. That process, using the onboard arcjet motor, could take up to several weeks. The AO-40 team hopes the maneuver will minimize or eliminate possible effects on the satellite's orbit caused by atmospheric ex-

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American space tourist Dennis Tito (R) talks to mission control aboard the International Space Station April 30, 2001, after arriving aboard the space capsule Soyuz. Tito, a 60-year-old California investment broker who paid $20 million for his trip into space, is joined by Russian Commander Yuri Usachev, red shirt, American flight engineer Susan Helms, front, and Russians Talgat Musabayev, top right, and Yuri Baturin, top left. (RTV via Reuters)

pansion at the peak of the solar cycle.

AO-40 currently is approximately 200 miles above Earth at perigee and some 31,600 miles at apogee. Plans call for raising the orbit at perigee to around 320 miles. The maneuver would "hardly affect" the satellite's apogee, Haighton said. The arcjet would be operated without electrically igniting it — using the pressure of the ammonia fuel alone. This would yield about half the normal thrust, Haighton said.

Once the orbit has been adjusted, ground controllers would orient the spacecraft's attitude and check out the various onboard transmitter and receiver systems to see what works and what does not. "We're still pretty confident that the 2-meter and 70-cm transmitters are not there," Haighton said, "but we're equally confident that the receivers for those bands still are."

The satellite has been transmitting telemetry on the 2.4 GHz (S-2) beacon, and signals reportedly have continued to improve – although the beacon has been out from time to time as needed to conserve power during eclipse periods. Ground controllers recently commanded the YACE camera to take several pictures, starting with orbit 216, and 11 images were downloaded. "The pictures show the characteristic rings and blisters that have been detected on the YACE photographs since the December 13 incident (damage to the lens from fuel residue?)," said a posting on the AMSAT-DL Web site. A prevailing theory about the image degradation was that the camera may have been damaged by direct sunlight into its lens, but James Miller, G3RUH, in an analysis subtitled "Did the Cameras Fry?" has disputed that notion.

Full deployment of the spacecraft's solar panels is still "down the road at least two to three months," Haighton said. Also uncertain was the satellite's ultimate inclination with respect to the equator. It was planned for AO-40 to have a 60-degree inclination, but given the satellite's compromised circumstances, "we'll be lucky if we can get 10 or 15 degrees," Haighton said. The current inclination is six degrees.

Paul Willmott, VP9MU, reported that additional pictures (using the YACE camera) were taken at the end of orbit 225. AO-40 then downloaded the photos via D-block telemetry through orbit 226. Paul reported that "we expect around 180 D-blocks in the complete set."

Moe, AE4JY, reported the following concerning his AO40Rcv Telemetry decoding program:

"I just found a nasty bug in the AO40Rcv program. It will crash if it is started in the minimized state. The bad part of this is that if the program is closed when minimized, it will always try to start up in a minimized state."

Moe reports a fix for this condition will be listed on the AE4JY web site in the near future.

AO-40 Opened for Amateur Radio Operation!

AO-40 experimental transponder operation began on Saturday, 05 May 2001, when the U-band and L1-band uplinks were connected to the S-2 transmitter passband downlink via the matrix switch. Operation has been extremely successful with many reports of AO-40 operation.

The following letter was received from Peter Guelzow, DB2OS from AO-40 Command Team:

Dear All,

After a very successful week of S-band transponder operation, the announced test of the 10 GHz X-band downlink was not successful. Michael Fletcher, OH2AUE, along with command station W4SM tested the X-band (both the solid state and TWT) systems, and, unfortunately, the test was not successful.

The IHU-1 telemetry indicated the proper commands were received, but no power is getting to any of the X-band modules. Nothing happened and even the status of the temperature sensors in the X-band modules did not change. The values did not change when the module was commanded on, thus the conclusion that there is no electrical power within the module.

The problem must be either in the 28-volt supply or in the module power control line

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from the IHU. This problem was never observed during all the testing in Orlando and Kourou. A software problem is very unlikely. It is planned to investigate this further in the next few days and another X-band attempt will be made soon.

S-band transponder operation will continue.

The LEILA system on AO-40 has been turned on for the first time! Recently, some very strong signals appeared in the passband, several dB louder than the middle beacon. At this time the AGC on the U-band receiver was suppressing up to 16 dB, clearly in sync with the strong transmissions. LEILA was switched into the U-band passband, (as seen by the MATRIX configuration). LEILA was configured for a SCAN/JAM/NOTCH mode and it worked like a charm! The threshold was set to a level which is approximately equal to the general beacon signal, which means any stronger signal will be detected by LEILA and a 'police siren' sound will first be heard to give the offending station a chance to reduce power, otherwise the notch will do it's best. Initial reports are that users in the passband loved it! This is the first time that such a system has been used in space for a transponder with uncoordinated multiple access.

Meanwhile, the RUDAK team has reported good progress with both CPU's running for more than 10 days. Jim White, WD0E, finished loading the GPS task into RUDAK-A and also loaded the CEDEX task. Both tasks are running but commands to begin their operations have not yet been transmitted. Jim also reported that RUDAK-A telemetry continues to look normal and the SmartNode temperature sensors on the CAN bus seem to work fine.

For the whole AO-40 Team:

73,

Peter Guelzow, DB2OS

AO-40 users are reminded that +/- 5 kHz around the Middle Beacon (MB) must be avoided. If the beacon cannot be copied due to interference with users in the passband, transponder operation may be stopped.

Mike Seguin, N1JEZ reported that he has been testing uplink conditions with AO-40 as he watched the AGC action on the passband. His recommendations have been posted on the AMSAT bulletin board. Mike reports that he "can't wait until AO-40 is stabilized and pointing right at us! I see great DXpedition potential for a small U/S system!"

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Dennis Tito, KG6FZX from the ISS

On 02 May 2001, Farrell Winder, W8ZCF in Cincinnati, Ohio made two contacts with the International Space Station. First was with Susan Helms, KC7NHZ during the 15:04 UTC pass over Cincinnati, Ohio. She used the NA1SS callsign. W8ZCF made the contact with KC7NHZ at 15:12 UTC nearing the end of the pass. Helms remarked that she had the day off and some free time for Amateur Radio. Susan then talked with W8IF. We both apparently asked about Dennis Tito and she remarked that he knew of the Amateur Radio setup aboard and thought he was planning to use it.

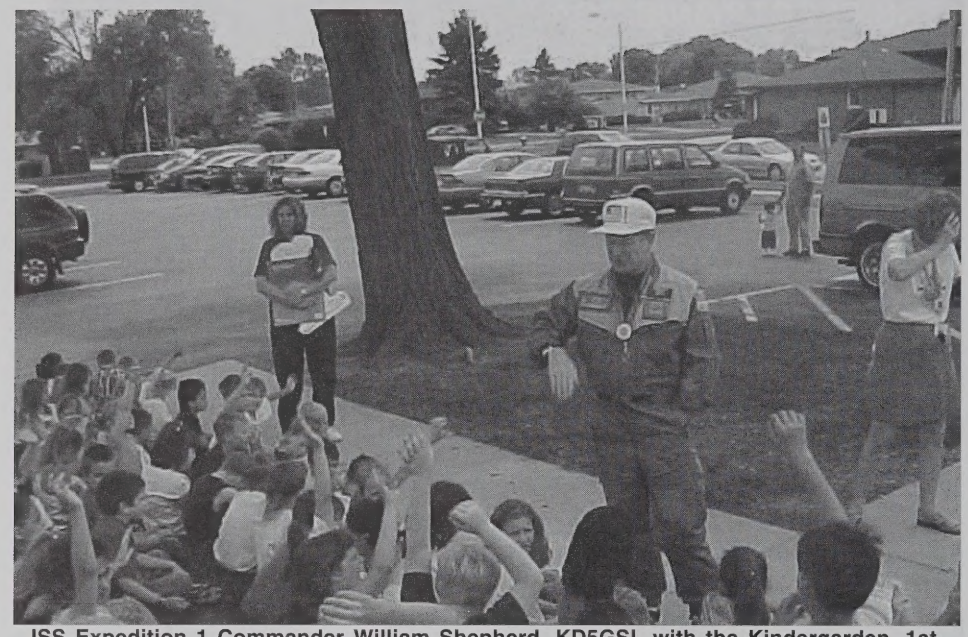
Susan was correct as during a pass at 1819 UTC, W8ZCF had an excellent contact of several minutes contact with Dennis Tito, KG6FZX. He also used the ISS call, NA1SS. At first W8ZCF didn't recognize his voice and asked, "Is this Dennis?" He replied right back saying "Yes, this is Dennis, and you are coming in loud and clear." W8ZCF asked how he was getting along, he remarked that he loves space and having a ball. He said it is the greatest experience of his lifetime. At the time he was over Canada and Farrell asked him what it looked like outside. He remarked that there is no window where the Amateur Radio equipment is located so he could not give me a report. Dennis was anxious to know what was being discussed about him on Earth. W8ZCF mentioned that MSNBC and CNN were running short video clips showing him boarding the ISS.

AMSAT Competes in SETI@Home

Almost 100 AMSAT members are crunching SETI data from their home computers. SETI@Home is one of the SETI projects that searches for extraterrestrial life. SETI@Home allows anyone with a computer and an Internet connection to take part in the search. By using the computer while the owner is away, the SETI@Home screensaver is able to search for extraterrestrial signals.

Recently, Tom Clark, W3IWI founded an AMSAT team to compete against other teams in processing SETI data. As of 07 May 2001, 91 AMSAT members have participated on the AMSAT SETI team and have produced over 110 years of CPU time. As a result, AMSAT is listed in 174th place based on providing of 55,485 data analysis results to SETI@Home.

AMSAT members interested in joining the AMSAT SETI team are urged to sign up via the SETI@Home WWW site.



ISS Expedition 1 Commander William Shepherd, KD5GSL with the Kindergarden, 1st, and 2nd Grade Students of Burbank School, IL.

Bill Shepherd, KD5GSL Visits Burbank School

Charles Sufana, AJ9N

On 10 May 2001, of ISS Expedition 1 Commander Bill Shepherd visited with students of Burbank School in Burbank, IL. The Burbank school made the first ARISS school contact in November 2000 (see January/February issue of *The AMSAT* Journal). The convocation was absolutely outstanding as the school had put in a great deal of effort into the planning. I was able to have lunch with Commander Shepherd allowing us to have a nice discussion about the ARISS program. He is very interested in the educational aspects of the ARISS program. There were several representatives from Adler Planetarium there also and Commander Shepard asked many questions about their space education program.

After lunch, everyone (and I mean about 500 or so students) went into the gym. After hearing the orchestra play and several introductory speeches by the Burbank Principal Bob Mocek and the coordinating teacher Rita Wright, everyone sat spellbound as Commander Shepherd presented a talk about his days on the ISS. He also showed a videotape that showed life on the ISS; all of which we had never seen before. All throughout his talk, questions were addressed from the students; what a thrill for the students!

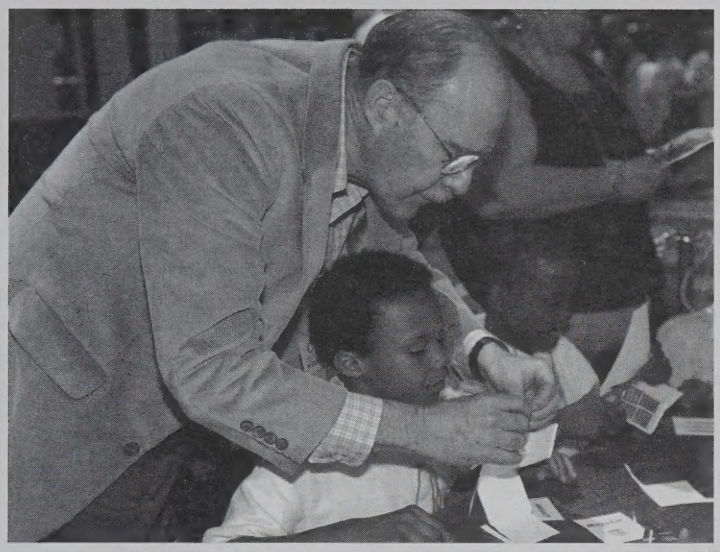
After the speeches were given, numerous autographs and pictures were taken. I even had my Burbank ARISS t-shirt signed. I actually had to sign a few autographs myself for the students on their t-shirts. All and all, it was a fun afternoon for the students at Burbank. I wish to thank Burbank for inviting me to come. I know I am seconding Burbank's thank you to Commander Shepherd for his visit.

CQ Announces Inaugural Class of CQ Amateur Radio Hall of Fame

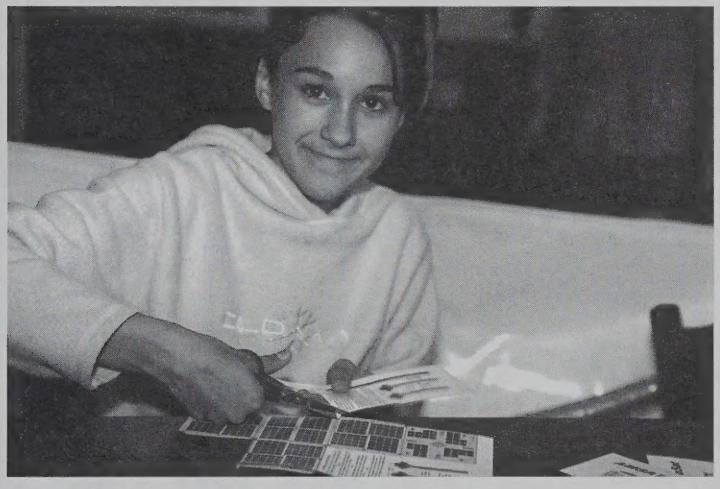
CQ Amateur Radio magazine announced the inaugural group of 50 inductees into the CQ Amateur Radio Hall of Fame. The Amateur Radio Hall of Fame was established in January, 2001, to recognize those individuals, whether licensed radio amateurs or not, who significantly affected the course of Amateur Radio; and radio amateurs who, in the course of their professional lives, had a significant impact on their professions or on world affairs. Over 100 names were placed in nomination, and 50 were selected for the inaugural class. Their names are listed below, in alphabetical order.

1- Armstrong, Edwin Howard — Laid the groundwork for modern radio through such inventions as the regenerative receiver, the superheterodyne receiver and frequency modulation (FM).
2- Bardeen, John - Co-inventor of the transistor, the basis of all modern electronics.
3- Brattain, Walter - Co-inventor of the transistor.
4- Clark, Tom W3IWI - Leading authority on Very Long Baseline Interferometry; amateur satellite pioneer, president of AMSAT, digital communications pioneer.
5- Collins, Art 9CXX/W0CXX - Founder, Collins Radio Co.; set the standard for Amateur Radio equipment in the 1950s, 60s and 70s.
6- Cowan, Sanford - Founding publisher, CQ magazine.
7- DeForrest, Lee - Invented the vacuum tube, basis for the growth of electronics and radio communication.
8- DeSoto, Clinton W1CBD- QST Editor, originated DXCC, credited with keeping ARRL alive during World War II, when amateur radio was shut down.
9- Ferrell, Oliver P. "Perry" - Propagation expert, CQ editor and propagation columnist, founding editor of Popular Electronics; introduced propagation science to Amateur Radio.
10- Fisk, Jim W1HR/W1DTY- Founding editor, ham radio magazine; set new standard for Amateur Radio technical publications.
11- Gandhi, Rajiv VU2RG - Prime Minister of India.
12- Garriott, Owen W5LFL - Astronaut, first ham to operate from space.
13- Godfrey, Arthur K4LIB - Entertainer, TV host
14- Goldwater, Barry K7UGA - U.S. Senator, 1964 Republican Presidential Candidate; Amateur Radio's leading proponent in Washington.
15- Gonset, Faust W6VR - Amateur radio author and technician, founder, Gonset Laboratories; brought affordable VHF equipment to amateur market.
16- Green, Wayne W2NSD - Founding editor/publisher, 73 magazine; former CQ editor/columnist; published Byte, the first consumer computer magazine.
17- Gross, Al W8PAL - Invented handheld radio transceiver (walkie-talkie), telephone pager and cordless telephone.
18- Hertz, Heinrich - Set the stage for radio by proving that electricity can travel in waves and developing the concepts of frequency and wavelength. The Hertz is the international unit of frequency.
19- Hoover , Herbert Jr. W6ZH - U.S. Under-Secretary of State; ARRL President
20- Hussein Ibn Talal, JY1 - King of Jordan
21- Jacobs, George W3ASK - Radio propagation expert, CQ columnist for 50 years, amateur satellite pioneer. HF broadcast engineering expert, developed Voice of America's worldwide broadcasting system.
22- Juan Carlos EA1JC - King of Spain
23- Jue, Martin W5FLU - Founder and President, MFJ Enterprises; changed the way amateurs buy station accessories.
24- Karn, Phil KA9Q - Developed basis for wireless Internet communications by adapting Internet communications protocol (TCP/IP) for radio use;
25- Kraus, John W8JK - Authority on radio astronomy, antennas; inventor of W8JK antenna
26- Krenkel, Ernst RAEM - Polar explorer, expedition communicator, Russian radio hero, made first Arctic-Antarctic radio contact (Note: RAEM was Krenkel's amateur callsign)
27- Laine, Martti OH2BH - Telecommunications expert, noted DXer, DXpeditioner, has introduced or re-introduced Amateur Radio to several countries.
28- LeKashman, Larry W2IOP/W2AD - President of ElectroVoice; manager at RCA, Lafayette and Bogen; early CQ editor
29- LeMay, Gen. Curtis W6EZV - US Air Force Chief of Staff, 1968 Candidate for Vice President of the United States (American Independent Party).
30- Leonard, Bill W2SKE - President of CBS News
31- Marconi, Guglielmo - Developed radio into viable communications medium; experimented with short waves, UHF and microwaves before most people knew they existed.
32- Maxim, Hiram Percy, W1AW - Co-founder, ARRL, founding editor, QST
33- McCoy, Lew W1ICP - Amateur radio writer, educated thousands about preventing TVI
34- Morse, Samuel F.B. - Developed the telegraph, the first viable electronic communication system.
35- Orr, Bill W6SAI - Prolific amateur radio author, historian, CQ and Ham Radio columnist, amateur satellite pioneer, editor of Radio Handbook.
36- Potts, John - Founding editor, CQ magazine.
37- Reber, Grote W9FGZ - "Father" of radio astronomy
38- Scherer, Bill W2AEF - CQ Technical Director, developed antennascope and brought grid dip meter to Amateur Radio.
39- Senti, Eugene W0ROW — As engineer for Collins Radio, invented the radio transceiver (transmitter and receiver in a single package, with shared
circuitry)
40- Shepherd, Jean K2ORS - Entertainer, radio host
41- Shockley, William - Co-inventor of the transistor.
42- Stoner, Don W6TNS - Amateur Radio writer, CQ columnist, amateur satellite pioneer.
43- Sumner, Dave K1ZZ - ARRL Executive Vice President, noted DXer and contester; has guided amateur radio through several World Radio Conferences.
44- Taylor, Joe K1JT -Physicist, discovered binary pulsars, for which he won (along with Russell Hulse, ex-WB2LAV) the Nobel Prize for Physics.
45- Tesla, Nikola - Developed alternating current as means of efficiently generating and distributing electricity; also invented HF generators and the Tesla coil. Is said by some to have beaten Marconi in the development of radio itself. The tesla is the international unit of magnetic flux.
46- Tuska, Clarence, 1AY - Co-founder, ARRL.
47- Uda, Shintaro - Co-inventor (with Hidetsugu Yagi) of Yagi-Uda antenna
48- Vail, Alfred - Built Morse's first telegraph, developed the code that bears Morse's name.
49- Weil, Danny VP2VB - Popularized DXpeditioning
50- Yagi, Hidetsugu - Co-inventor (with Shintaro Uda) of Yagi-Uda antenna

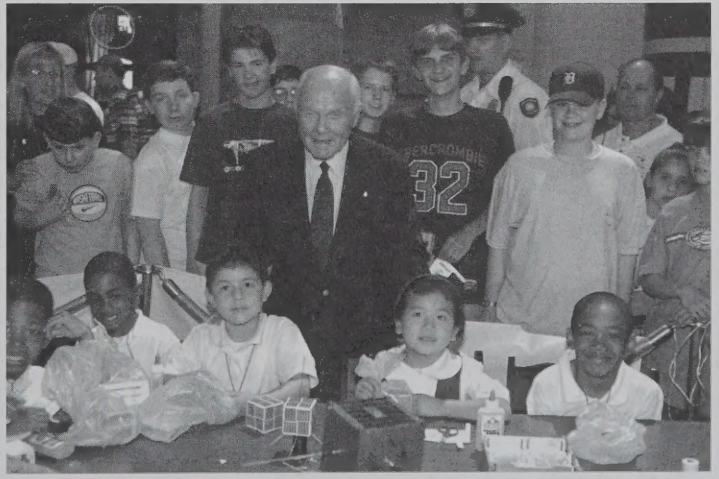
AMSAT at National Space Day!



AMSAT Board of Director Dick Daniels, W4PUJ (above) assists a student in the finer points of microsatellite model construction. Meanwhile, AMSAT Corporate Secretary Martha Saragovitz and Perry Klein, W4PUJ (right) proudly display their completed products (constructed without any technical mentoring from W4PUJ). (Photos by Art Feller, W4ART)



AMSAT member Steve Thompson, K5PK designed a micosatellite model construction kit for this special occasion. (K5PK also recently designed a best selling Phase 3D model for AMSAT members.) During the event, many students took time to construct their own microsatellite model and of the above group, perhaps there is a constructed model is now hanging in the room of a future AMSAT satellite builder? (Photo by Art Feller, W4ART)



Senator and Astronaut John Glenn took time to visit the AMSAT exhibit to meet with members and guests. Perry Klein, W4PK and Martha Sargovitz obtained an autograph from Senator Glenn (left). Students from the Amidon Elementary School in Washington, DC (right) shared a memorable moment with the legendary Astronaut Glenn. (photos by Art Feller, W4ART and Perry Klein, W3PK)

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